

MARINE ENGINEERING.

Vol. I.

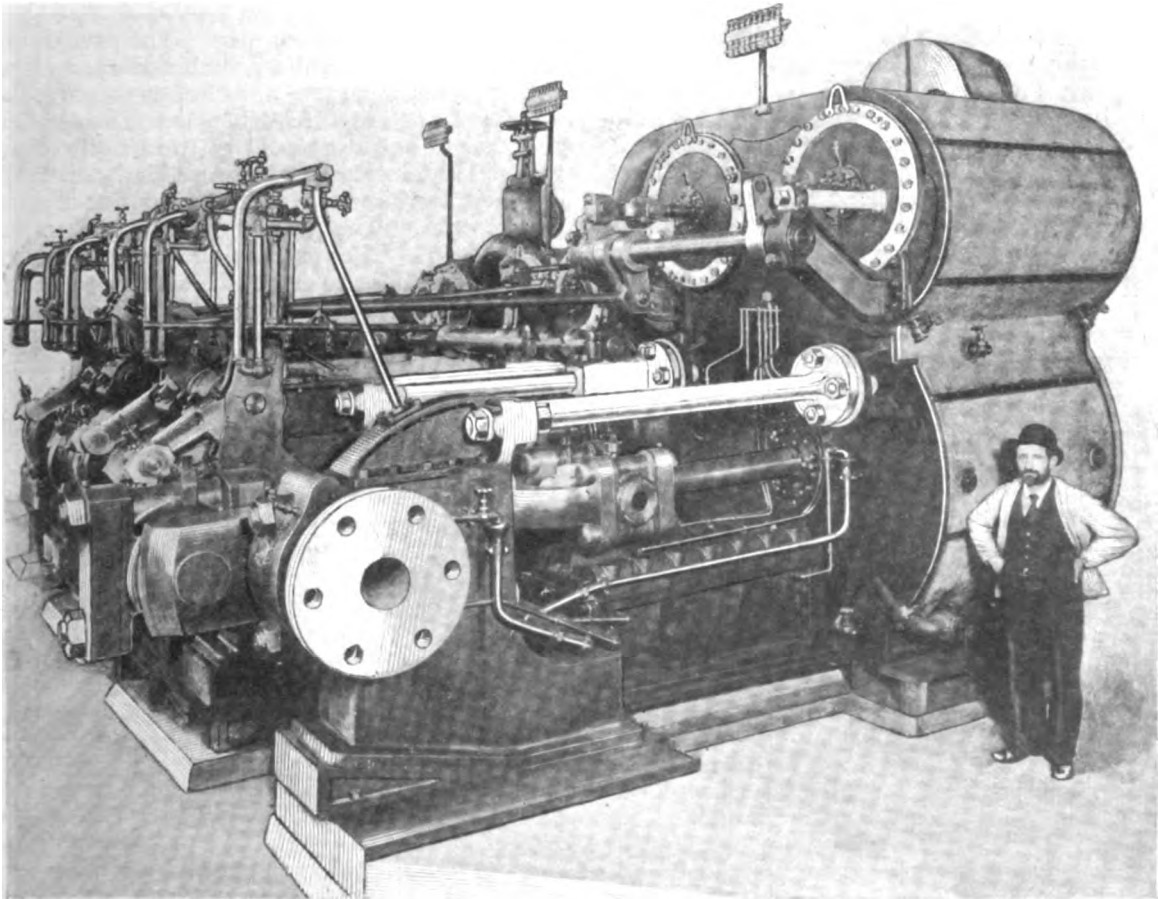
NEW YORK, APRIL, 1897.

No. I.

NEW HORIZONTAL ENGINES FOR U. S. CRUISER CHICAGO.

U. S. S. Chicago, which is in dry dock, in the Brooklyn Navy Yard, will soon be fitted with the new machinery which has been completed in the yard shops. This unarmored cruiser, which was one of the original White Squadron, is of 4,500 tons displacement. When

spread of canvas and increasing the offensive powers of the vessel. The engines taken out were of a peculiar compound beam type, and it was decided to replace these with horizontal direct-acting triple-expansion engines. These are expected to develop 9,000 horse-power under forced draught, sufficient, it is estimated, to give the Chicago a maximum speed of $18\frac{1}{2}$ knots an hour. The designs for the engines and boilers

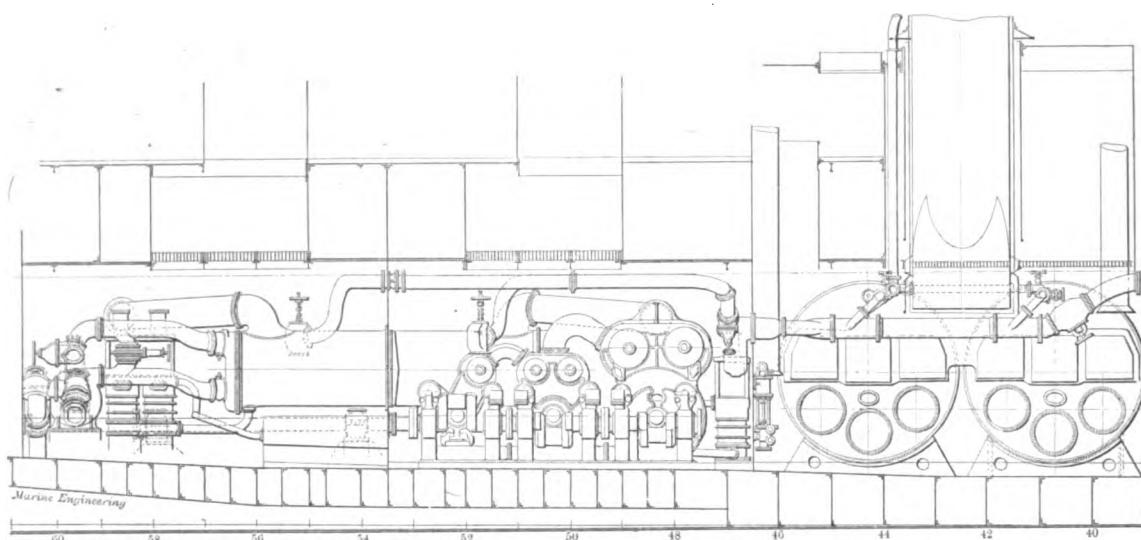


PORT ENGINE U. S. S. CHICAGO IN NAVY YARD SHOPS.

launched in 1884 she made 15 knots with 5,083.7 horse power on her trial trip. The navy authorities decided to make very radical changes in the Chicago by putting in more powerful engines, replacing the heavy square rig by a fore and aft

were prepared by the Bureau of Steam Engineering under the direction of Engineer-in-Chief, George W. Melville, U. S. N.

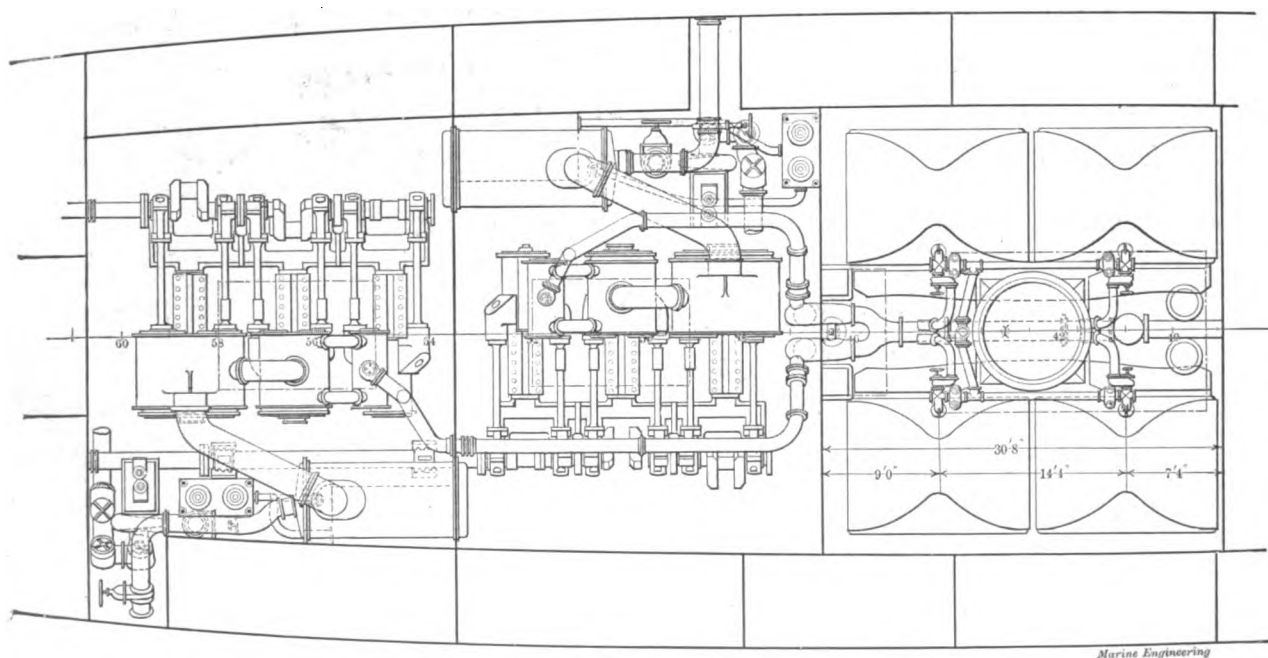
With the change of engines, a new set of boilers was a necessity and after deliberation the



GENERAL ARRANGEMENT OF MACHINERY, U. S. S. CHICAGO—ELEVATION.

bureau adopted a combination of the cylindrical and sectional types. Consequently the Chicago is to have four Scotch boilers, which have also been built in the Brooklyn yard, and six Babcock & Wilcox water tube boilers supplied by the patentees. The type of engines used was necessary to get the machinery below the water line, as the Chicago has no side armor. There is a protective deck over the machinery spaces $1\frac{1}{2}$ in. thick which has been extended right fore and aft. This is pierced for gratings below the engine room skylights. In the accompanying drawings the general arrangement of the new

machinery will be seen in part. The portion not shown is forward of the Scotch boilers, and includes the blower space and further forward, the room for the water tube boilers. The engines and boilers occupy 140 ft. of the length of the vessel. Measuring from forward aft the B. & W. boilers occupy 42 ft., the blower room 12 ft. 4 in., the Scotch boilers, 30 ft. 8 in. and the engine room, 55 ft. The extreme height of the machinery spaces is 20 ft., from inner floor of the double bottom to the protective deck overhead. The machinery space does not extend the full width across the ship as a belt of coal 7 ft. thick



GENERAL ARRANGEMENT OF MACHINERY, U. S. S. CHICAGO—PLAN.

is carried along the sides the full height of the machinery.

The engines as will be seen from the engraving, are of very handsome design, symmetrical, compact and yet with all parts easy of access. Their construction has been carried out with skill and thoroughness. With the single exception of the crank shafts, which were delivered at the Navy Yard in the rough, every pound of the material was produced in the various shops. A description of one engine will apply to both as they are the same in all essentials, differing only in such details as are made necessary by their respective positions to port and starboard. The port engine is shown in the cut. This has three cylinders, 33½ in., 50½ in., and 76 in. dia., and 40 in. stroke. Steam will be supplied at 180 pounds pressure and when going full speed the engine will make 135 revolutions. The main bed plate is made up of box sections, three of which carry the main bearings while three distance pieces bear the slides on top, and are bolted to projections cast on the front ends of the cylinders.

The cylinders are also of cast iron, jacketed, 1½ in. thick in the body, and fitted with liners of hard cast iron 1¼ in. thick. The pistons are of cast steel, dished, of very light weight, and each is fitted with two cast iron rings ⅝ in. on the faces, and ¾ in. deep, set out with elliptical springs. Piston valves are fitted to each cylinder; one 18 in. dia. to the H. P.; two 18 in. dia. to the I. P. and two of 30 in. dia. to the L. P. cylinders. The valve seatings are fitted with hard cast iron liners and the valve bodies and rings are of composition metal. The valve spindles run free through the inboard ends of the valves, a feather preventing any twisting motion. The outboard ends are secured by a taper and fitted with tail rods. These work through bushings in the covers and as the valve spindles also work in bushings, in the front ends, all weight is taken off the stuffing boxes. Any bushing can be removed and replaced with little loss of time. The stuffing boxes throughout are of the Watson patents. The valve rods of the H. P. and I. P. cylinders are 3 in. dia. those of the L. P. 3½ in. dia. The piston rods are of mild steel 7 in. dia. fitting in the cross heads in a taper 11½ in. long. The cross heads are made of cast steel with slippers of manganese bronze, babbitted, 24 in. long and 18 in. wide. Cast iron is used for the guides which are kept cool by water jackets. The connecting rods are 7 ft. 2 in., centers 7¾ in. dia. at the throat, and 8 in. at the large end, and they are bored with a 4½ in. hole reduced to 2 in. near the forks. The cross head journals measure 8 in. dia. and 8½ in. long, while the crank pins are 14½ in. dia. and 16 in. long. The big ends are of composition, babbitted and held together by bolts, 2 to each rod, 4½ in. dia.

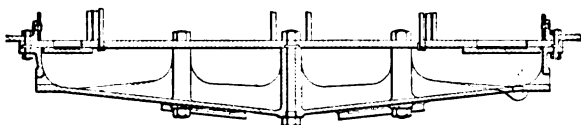
Open-hearth steel is the material used in the crank shaft, which is 22 ft. 0¾ in. long, 14 in. dia. in the body and 14 in. by 16½ in. in the main

bearings, with an 8 in. hole through the bearings and pins. It is made in three sections, bolted together with couplings 2 ft. 4 in. dia. and 3¼ in. thick, each pair connected with six 3 in. bolts. Each section weighs 2½ tons. The cranks are set at angles of 120 deg. The crank webs are 17 in. wide and 9½ in. thick, with the corners rounded off. The valve gear is of the well-known Marshall patent, which necessitates the use of only one eccentric for each cylinder. The cylinders are isolated one from the other so that free passage between is permitted for oiling and examinations. Between the L. P. and I. P. cylinders the steam reversing engine is bolted to the L. P. cylinder. The starting platform, which has heretofore been fitted over the motion in engines of this type, is placed on a level with the bed plate. The levers are attached to a plate secured to the tie rod on the H. P. end of the engine. This brings the starting gear for both engines close together and admits of ready observation as the direction in which each engine is turning. It will be noticed that the engines overlap, the keel being in the same vertical plane with the front ends of the cylinders. The main stop valve of the engine, which is seen directly over the H. P. valve chest, acts also as the throttle valve. It is a Hornblower double beat balanced valve. The main steam pipe is 12 in. dia., of cast steel, and the exhaust 27 in. dia. The mains connecting the I. P. and L. P. receivers are of copper. The rocking shaft which communicates the motion of the eccentric rods to the valve spindles of the L. P. cylinder is 5½ in. dia., carried by cast iron brackets bolted and stayed to the cylinder head. That for the I. P. cylinder is 4½ in. dia., carried in bearings secured to squares on the inboard ends of the tie rods. Over portion of this length of shaft a sleeve is fitted 8 in. dia., which carries the levers of the reversing gear. The eccentric rod for the H. P. cylinder is joined direct with a forked end to the valve spindle, without the intervention of any levers or guides. The tie rods are 6 in number of 5 in. dia. flanged at the ends and held fast by heavy turned bolts and nuts.

It will be noticed the engines are inclined slightly downwards, the center line making an angle of less than 4 deg. with the horizontal. The shafts are parallel with each other and with the base line. Lubrication is secured by a gravity system and a convenient arrangement of water pipes is carried over the crank shaft. Turning gear is fitted between the engine and tail shaft. The thrust shafts are of open hearth steel, 24 ft. long and 13¼ in. dia. There are 13 collars on each shaft, 17½ in. dia., and 1½ in. thick. The tunnel shafting is 14½ in. dia. and the propeller shafts are 15 in. Over all the starboard shafting is 138 ft. 8 in. long. Manganese bronze is used for the propellers which are 13 ft. dia. and 14 ft. pitch, three bladed and a modified Griffiths' design.

Machine steel is used for the shells of the con-

densers which are cylindrical 5 ft. 8½ in. dia. and 11 ft. 6 in. between tube sheets. Each contains 3,399 Muntz metal tubes ⅝ in. O. D. of 18 B. W. G. fitting into stuffing boxes at the ends and giving a total of 6,380 sq. ft. cooling surface. The tube sheets are 1 in. thick. Each tube is a snug fit through the inner side of the sheet for a distance of 3-16 in. From there to the outside of the sheet, the tube holes are ⅞ in. dia. screwed and fitted with ferrules ⅝ in. deep which leaves a space for packing with corset lacing. No inside stays are used, the tube sheets being braced to the condenser heads at each end in the manner shown in the cut. The section shows the strength-



CONDENSER HEAD AND TUBE SHEET.

ening webs which connect the bolt sleeves. There are five 1½ in. tie bolts in each head, one in the center, and the others equally spaced around. The outer flanges of shell and covers are held together at each end by ¾ in. bolts.

Independent vertical duplex direct-acting air pumps built by Marshal T. Davidson are used. The steam cylinders are 12 in. dia., and the pump chambers 25 by 18 in. The circulating pumps and engines were built in the yard shops. The engines are compound, with cylinders 6½ and 9¾ in. by 8 in. stroke. The centrifugal pumps which they drive have fliers 36 in. dia. and 2½ in. width of face. The suction and discharge openings are 15½ in.

As the Chicago will be worked under forced draught on the closed stokehold system when running at the higher speeds, blowers are fitted in the space between the two boiler rooms. There are 4 fans each 66 in. dia. with 12 in. blades. The blower engines are double, with cylinders 5 by 5 in. and cranks set at right angles. The blowers are arranged in pairs, two on each side of the keel line, the engine shaft of each extending in-board and connecting with couplings so that if necessary the port engines could drive all four blowers, and vice versa. The boilers include four single ended Scotch type 13 ft. 9 in. dia. by 10 ft. 3 in. long with 273 sq. ft. grate and 8,552 sq. ft. heating surface, and six Babcock & Wilcox water tube boilers containing 360 sq. ft. grate, and 18,000 sq. ft. heating surface. This gives a total available grate surface of 633 sq. ft. and 26,552 of heating surface. It is estimated that the Scotch boilers will drive the ship 13 knots and with the water-tube boilers added, 18.5 knots can be had. The bunker capacity is 918 tons.

The construction and erection of this machinery, in the yard shops, has been carried out under the direction of Chief Engineer Edward Farmer, U. S. N., and his staff.

NOTES ON LIQUID LUBRICANTS.

BY HENRY E. CUTTS, A. M.

In order to work an engine economically it is necessary to prevent, as far as possible, any waste of power. A very important factor in the total of waste is the amount of energy lost in overcoming the friction of the moving parts. More attention is now given to the elimination of this source of loss than in time past, but even now lubrication is not accorded the place it should hold in the economy of the engine room.

The friction of solid bodies sliding on each other is very considerable, varying with the material, and the pressure applied to the parts in contact. The friction of liquids moving on each other is much less than that of solids, as solid surfaces are of an entirely different character. The molecular structure of a solid is fixed, while the molecules of a liquid move readily, changing their relative positions with ease, the speed varying in different portions, increasing and diminishing in zones parallel to the direction of motion. For example, in a liquid medium between two solid surfaces, one in motion and the other at rest, that part next the moving surface moves with the same speed as the moving surface, while the speed of the liquid gradually diminishes until that portion of the liquid next the surface at rest is also at rest. For this reason a liquid acts as a lubricant between the bearing surface of an engine. In order that the friction of the liquid itself be as small as possible, there should be only a mere film between the bearing surfaces, yet, sufficient to prevent them touching at any point. It thus becomes necessary that the liquid used as a lubricant be of such body that a thin homogeneous layer will be, at all times, interposed between all points of the bearing surfaces.

Theoretically, friction is equally small in liquids as compared with solids, but practically, of all liquids, oil is found to be the best adapted for lubricating purposes from its possession of an innate property known as greasiness. In earlier days of engineering knowledge animal and vegetable oils were used for lubrication of lighter bearings, while for large masses and heavy pressures, greases, which liquefy at temperatures above the normal, were necessary. In latter times, however, hydrocarbon, that is, mineral oils or compounds, containing a large percentage of mineral oils have been largely substituted, mainly because they are freer from objectionable qualities.

When mineral oils came into use as lubricants the specific gravity, showing the weight of an oil, was supposed to give a good indication of its quality. It was soon found, however, that mixtures of light and heavy hydrocarbon oils could be manufactured, which would have the same specific gravity as homogeneous oils of good lubricating power, but would be far inferior to them in this essential. Consequently it became necessary to apply other tests to the hydrocarbon

oils. Of these the most important is the test to ascertain the viscosity or fluidity at the ordinary temperatures of use. With animal or vegetable oils this test is not of so great importance, as the viscosity varies but little in different samples of the same kind of oil. Lard oil has a certain viscosity, as also have sperm, rape, castor, etc., and their viscosities diminish but little with the rise of temperature. So an engineer had to but order a certain kind of oil and be sure of its possessing the same lubricating power as the oil he was then using. With the advent of mineral oils it became necessary for him to know the viscosity of the oil which he found satisfactory in use, so that in ordering fresh supplies he would be sure to get oil of the same lubricating power. The fact that he purchased mineral oil was not of itself sufficient to indicate its lubricating quality. Neglect of this precaution invariably resulted in trouble in the engine room.

There is, however, a great variation of viscosity in mineral oils at different temperatures, so that an oil of the proper body at, say, the temperature of the shaft bearings would be entirely too light at the temperature of the cylinders. This makes imperative a knowledge of the viscosity at several temperatures in order to get effective lubrication. For the measurement of viscosity there are many devices, unfortunately too many, and there is consequently no fixed scale of viscosity. Oils can be compared only by testing with the same kind of instrument and the comparison based on some oil of constant viscosity, as a sperm oil. In the majority of the viscosimeters used for this test a given volume of oil is allowed to run through a small orifice and the time occupied in its passage noted; for it has been proven that the friction in a liquid flowing through a small tube is of the same character as when the same liquid is interposed between moving surfaces. The accompanying table shows the variation in viscosities of different oils at different temperatures, and particularly the great decrease in the viscosity of mineral oils as the temperature rises.

VISCOSIMETER TESTS.

Kind of Oil.	Time of flow at Temp. F.		
	70 deg.	100 deg.	212 deg.
Sperm.....	88 sec.	66 sec.	42 sec.
Lard Oil.....	130 "	89 "	58 sec.
Engine Oil (Mineral) Sp.Gr. .0.911	284 sec.	90 sec.	45 sec.
Engine Oil (Mineral) Sp.Gr. .0.920	495 sec.	113 sec.	49 sec.
Cylinder Oil (Mineral) Sp.Gr. .0.887		800 sec.	78 sec.
Cylinder Oil (Mineral) Sp.Gr. .0.890		1500 sec.	94 sec.

Although the lubricating power of an oil is of prime importance, it is not the only property to be considered. Many oils of good lubricating power are not the best oils to use in the engine room. An oil should not have too low a flash-

ing point, which is the temperature at which the vapor given off would catch fire. A low flashing point is not only an indication of possible danger in using the oil, but shows an admixture of light hydrocarbons, the presence of which is due to improper manufacture, or to their addition to lighten a too thick or viscous oil. If an oil is to be used in exposed places, or in a cold climate, it should not, on the other hand, solidify at too high a temperature. Again, care must be taken in the selection of an oil so that it will not gum nor decompose at the temperature at which it is to be used. Gummying is due, in some oils, to the nature of the oil itself, vegetable oils, for instance, slowly absorb oxygen from the air and form a sticky layer where applied, which, with one or two exceptions, prevents their use as lubricants for machinery. In other oils, gummying is due to matter left in the oil when it is marketed, the refining process being imperfectly carried out. Or again, it may be caused by the addition of foreign matter to give weight or body to the oil. As to decomposition, or turning rancid, animal oils undergo this chemical change through the application of heat, the action of the air, or of steam, or too long keeping even under ordinary conditions. The change converts the lubricant into a mixture of glycerine and free fatty acids, which latter are corrosive in their action, and by constant application to the metals in contact dissolve portions, causing what is known as pitting. As mineral oils do not contain any fatty acids and do not decompose under service conditions, they act less on metals than any other liquid lubricant. This property, among others, has so well come to be recognized, that in many steamship lines only hydrocarbon oils are permitted as lubricants. These, however, are in very many cases, and especially so in the brands sold for cylinder use exclusively, composed of mineral oil, with a slight admixture of animal oil, so the presence of free fatty acids has to be considered in their use.

The selection of oils is a difficult matter, as many of the more delicate tests cannot be effectively made without experience and the use of proper apparatus. Laboratory tests, while absolutely essential, are not conclusive, for it is the behavior of an oil, under service conditions, that must always govern its use as a lubricant. Starting with a poor oil, efficient lubrication manifestly cannot be accomplished, while given an oil, good as far as the scientist can determine, the practical conditions under which it is applied may render it of little value.

The British Navy estimates for 1897-98 show a decrease on the previous year's expenditure, for shipbuilding and engineering of warships, for the item of shipbuilding and engineering of warships, of \$2,500,000. The total estimates for the fiscal year which begins April 1 are \$109,190,000, or slightly more than was expended last year.

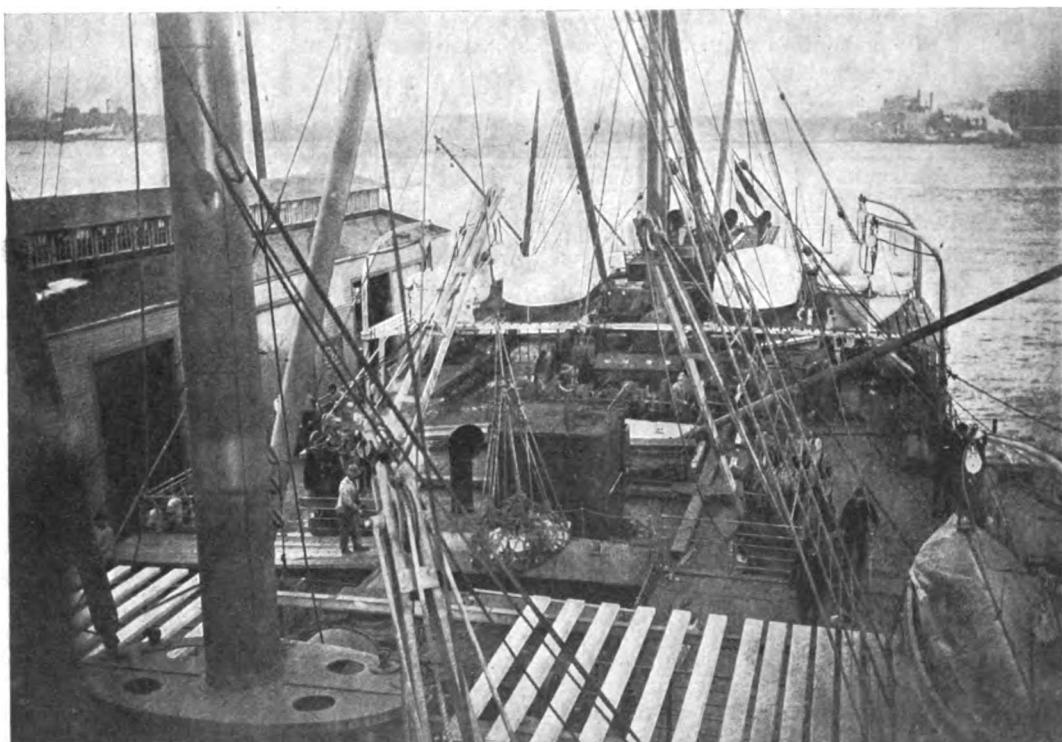
LARGEST FREIGHT CARRIER AFLOAT.

When the Hamburg-American twin-screw freight and passenger ship *Pennsylvania*, left the port of New York on her first eastward voyage, February 18, she carried away a miscellaneous cargo of 11,999 long tons dead weight. Her mean draught with this load in the cargo space, with 1,450 tons of coal and all stores aboard, was $31\frac{1}{2}$ ft. The dimensions of this marine monster are: Length, 560 ft.; beam, 62 ft., and depth, from keel to awning deck, 42 feet.

The *Pennsylvania* is a good example of an increasing type of ocean vessel which is designed to be a profitable freight carrier, and yet afford such comforts and conveniences for passengers,

the hull is graceful, but the straight pole masts and funnel give the boat an awkward appearance.

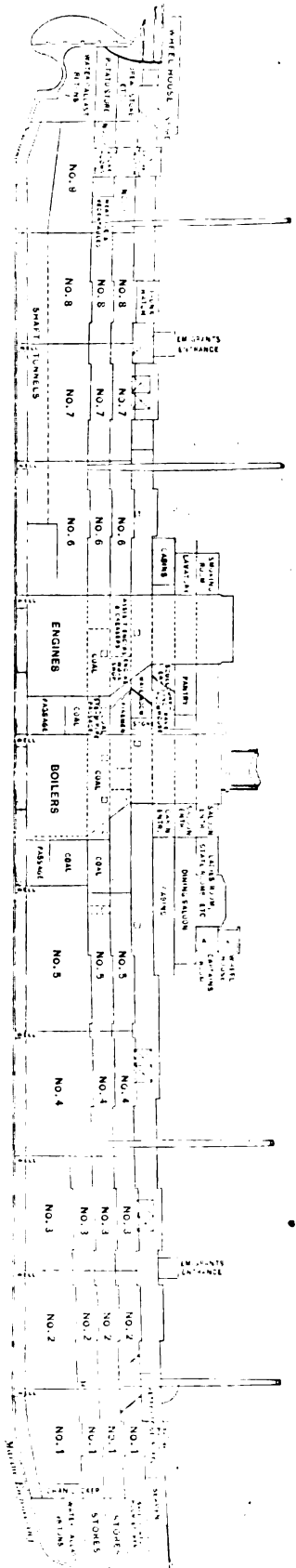
Reference to the sectional diagram will show the interior arrangements. There are eight decks in all, though only four run the entire length of the hull. There is a double cellular bottom extending the length of the keel, the distance between the floors being 4 ft. This is used for water ballast, the total amount which can be carried being 1,896 tons. The decks are; lower deck, between deck, main deck, upper deck, and awning deck, in the hull, and in the superstructure, or bridge, amidships saloon deck, promenade deck and boat deck. The awning deck runs flush from stem to stern, and is used for working the vessel. The lower deck extends aft from the stem 148 ft. The



AWNING DECK S. S. PENNSYLVANIA LOOKING AFT FROM SALOON DECK.

as will attract many ocean travelers. To these considerations, and that of making a tremendously strong and seaworthy vessel, everything else has been subordinated. For this reason the general exterior of the ship could not be called handsome; nor in the interior is there any attempt at unnecessary, though possibly artistic, decoration which is to be found on most of the big liners. A good idea of the general appearance of the *Pennsylvania*, as she sits in the water, can be had from the accompanying photograph which was made upon her arrival in port. The proportions between the longitudinal and the vertical lines are not perfect, however, as she was in ballast when the view was taken. When loaded the great length is more apparent. The contour of

hull is divided into 12 water-tight compartments by transverse bulkheads, which extend to the upper-deck, and without openings; so that in case of collision or accident the safety of the vessel would not depend upon the possible working of automatic apparatus, or the promptness of the crew in closing doors. There are nine holds, and as many hatches, while for the speedy handling of cargo, there are twelve ordinary winches, and eight revolving steam cranes, each of 3 tons capacity. The general plan of this hoisting gear can be readily seen from the view showing the awning deck aft of the superstructure. The cargo capacity, exclusive of the trunk hatches and store rooms, is 720,630 cubic feet. The last named spaces give additional 5,800 and 24,060 cubic ft.



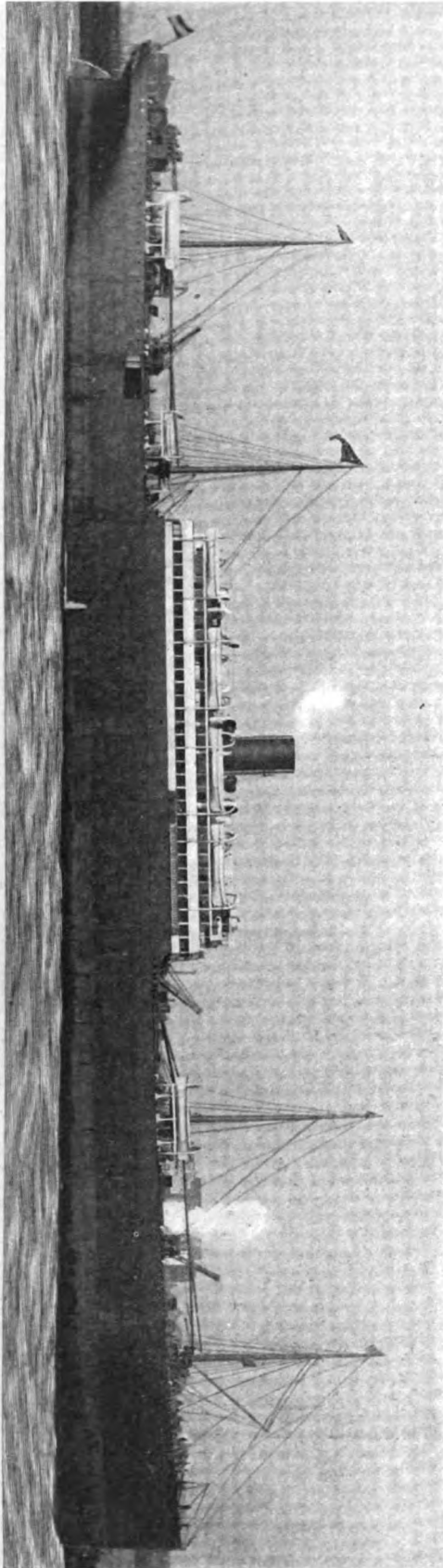
LONGITUDINAL SECTION STEAMSHIP PENNSYLVANIA.

respectively, and to this can be added the capacity of the shelter deck, giving a total of all cargo and store room of 211,762 tons of 40 cubic feet. There is also accommodation for 450 horses.

The pole masts are used for lookout, signal, and derrick purposes only, entire dependance being placed on the machinery for propulsion. They do not extend below the between decks. They are fitted in pairs, which helps to give the

vessel an odd appearance. The distance between each pair is 88 ft., and between the main and mizzen masts 243 ft. Exceptionally heavy anchor gear and steam windlass is fitted forward in the usual liner style, while aft a steering engine of the builder's patent, controls the rudder by a balanced tiller. The superstructure extends a distance of 158 ft. amidships, its center line transversely being 16 ft. aft of the center line

of the hull. The boat deck is 24 ft. above the awning deck, and on the awning deck the greater number of first-class state rooms are fitted. Here, also, are the cabins of the executive officers, and various work rooms of the steward's department. The dining saloon occupies the forward part of the structure on the promenade deck, and aft there is a lavatory, pantry and other like accommodations. The dining



HAMBURG-AMERICAN LINE STEAMSHIP PENNSYLVANIA.

room skylight is carried above the boat deck. On this deck the smoking and ladies' rooms are well furnished and equipped. In the forward end, the captain's room gives a commanding view



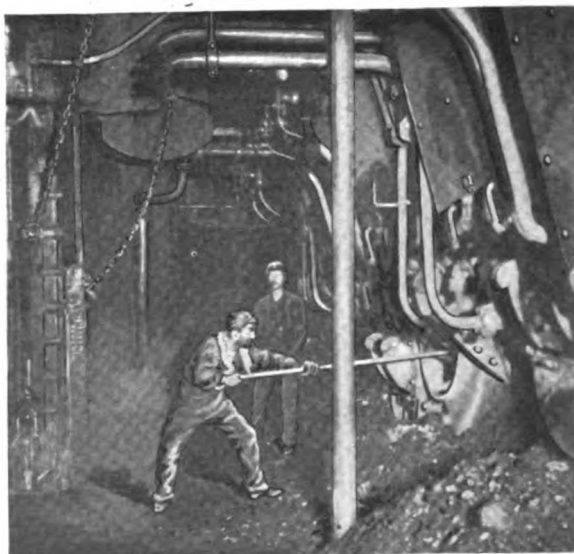
STARTING PLATFORM, STARBOARD ENGINE.

clear ahead. Above this is the wheel house, the top of which is 80 ft. above the keel. It is surmounted by a sort of flying bridge. On the saloon and promenade decks there is a wide, clear space around the cabins from which passengers can get an unobstructed view toward every point of the compass. The navigating officer's bridge is carried across the forward end of the boat deck, and in addition to the usual signal apparatus, is fitted with telegraphs communicating with the executive officers' stations fore and aft on the awning deck. There is accommodation on the upper and main decks for steerage passengers, the vessel altogether having room for 200 first cabin, 150 intermediate, and 1,000 steerage passengers.

The machinery is situated amidships, the forward end of the boiler room being about 30 ft. forward of the center of the ship. The coal is carried forward and aft of the boiler room and alongside the engine room in the lower 'tween deck spaces. The bunker capacity is 1,412 tons. The engine room is 38 ft. long, and the width of the ship, 62 ft., while the distance from the starting platform to the top of the skylight is a clear rise of 74 ft. The main engines are quadruple expansion with four cylinders and four balanced cranks built under the patents of Herr Otto Schlick. His investigations of the causes and prevention of vibration in steam vessels are well known, and these engines are a demonstration of his ideas. The cylinders are 23-in., 33-in., 48-in., and 69-in. dia., and are grouped in pairs at the ends of the crank shafts. The stroke is 54-in. and the engines at full speed make only 75 revolutions per minute. The disposition of the cranks can be readily seen in the accompanying diagram. The sequence of the cylinders looking

aft is high pressure, low pressure, second intermediate and first intermediate, thus getting the larger reciprocating parts between those of smaller dimensions. The distance between the piston centers of each pair is 6 ft. 5 in., while the distance apart in the middle is 12 ft. This makes an unusually roomy engine, as may be noticed from the position of the frames and fittings, in the cut. The first three cylinders have piston valves, and the low pressure a slide valve. The valve chests of the L.P. and second I.P. cylinders face each other, and those of the H.P. and first I.P. are on the ends, so that all the valves can be readily got at for inspection or repair. They are worked by the ordinary Stephenson link. In details of design the engines conform to the best modern marine practice. The frames are of the box pattern, and the crank shaft is built up and is 14½ in. dia. in the journals, and 14½ in. in the pins. The air and bilge pumps form part of the back frames and are worked by levers off the low pressure cross-head. In the center of the crank shaft the turning gear is fitted, and by a simple adjustment of the worm wheels, it is operated by the reversing engine, when the vessel is in port. The condensers are of compact build, and contain 7,280 sq. ft. of cooling surface.

In keeping with the usual practice of the builders, the shafts are carried inboard, and consequently they converge toward the stern to the extent of 4 ft. 6 in. The forward ends of the crank shafts are 17½ ft. apart, while the propeller centers are 13 ft. apart. In length the shafts are of unusual dimensions, being 227 ft. over all. The tunnel shafts are 13½ in. dia. and the propeller shafts 14½ in. The shafting is hollow,



FIREROOM ATHWARTSHIPS.

not to reduce weight, however, as the holes are of small diameter for purposes of inspection of the material only. The propellers are three-

bladed 16 ft. dia., and 21 ft. pitch, each weighing $9\frac{1}{2}$ tons. The port propeller is forward of the starboard 5 ft., and the blades overlap slightly.

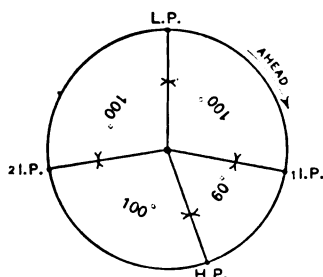
Steam is generated at a pressure of 210 pounds to the sq. in. in three double-ended Scotch boilers, 13 ft. 8 in. dia. and 20 ft. 6 in. long and two single-ended boilers of corresponding size. They are fitted athwartships and are worked under natural draught. There are twenty-four furnaces, with a grate area of 433 sq. ft., and the five boilers contain 15,025 sq. ft. of heating surface. The dia. of the funnel is 12 ft. and its top is 98 ft. above the grate bars. See's ash ejectors and also hoists are conveniently fitted.

rules of the Germanischer Lloyd, and the British Board of Trade. On September 10 last she was launched, and the machinery subsequently put aboard under the supervision of Herr John Korte, who represented the owners and who is now Chief Engineer of the Pennsylvania. She had proved herself a good sea boat when she reached New York on her first voyage, direct from the builder's yard. Though she was running light and the weather on the Atlantic was boisterous, she was very steady and maintained an average of $14\frac{1}{2}$ knots an hour. This voyage, however, was not of much engineering value in ascertaining economies or degree of vibration

Steamship.	Length ft.	Beam ft.	Depth ft.	Mean Drgt. ft.	Load dis. tons	Cargo tons	Bunker cap tons	I. H. P.	Steam P. lbs.	Speed knots	Pass. accom.
Great Eastern, Launched 1858	680	82.6	58.	30	27,384	6,000	10,000	actual 7,652 est 5,500	25.	13	4,000
Pennsylvania, " 1896	560	62.	42.	$31\frac{1}{2}$	23,400	12,000	1,450		210	$14\frac{1}{2}$	1,820

COMPARATIVE TABLE DIMENSIONS, ETC., GREAT EASTERN AND PENNSYLVANIA.

The auxiliary apparatus includes centrifugal circulating pumps, two Weir's boiler feed pumps, one of which is sufficient to maintain the water levels, also a Morrison's evaporator of twenty-five-ton capacity connected with the L.P. receiver and the main condenser. There is also an auxiliary condenser and a pair of powerful 6 in. duplex pumps with connections to all points, so that they can be used for ballast or other purposes. Attached to the forward bulkhead, over the passage leading to the boiler room, is a Weir's feed water heater, which receives the exhaust from the auxiliary engines, and is designed to raise the temperature of the feed to boiling point. In the recess between the thrust bearings, at a slightly lower level than the engine room floor, the electric light plant is fitted. There are three Allen's direct-driven dynamos, two of which are in regular use when the vessel is at sea, and the third in reserve. They run at 275 rev. per minute, each generator supplying current to 300 lamps of 16 candle power. There is also a compact Hall refrigerating machine here which maintains a low temperature in the provision rooms aft. There are in all 45 engines on board, containing 85 steam cylinders.



DISPOSITION OF CRANKS STARBOARD ENGINE
LOOKING FORWARD.

The Pennsylvania was built and engined in the yard of Harland & Wolff, in Belfast, Ireland. She has been constructed in accordance with the

which had been most carefully considered by the designer, for the vessel had no cargo aboard. The coal used, too, was the best Welsh steaming variety, and there was no difficulty whatever in keeping up the maximum pressure. In claiming for the Pennsylvania great stability, it is pointed out that she was launched and fitted out without a ton of water ballast aboard. In fact, her tanks were not filled until the trial trip. In the matter of heating, lighting, ventilation, toilet arrangements, etc., the ship is unusually well planned and equipped. Even the stokers and coal-passers enjoy the luxury of shower baths for their exclusive use. The equipment in the way of boats and navigating apparatus is also very complete.

The Pennsylvania will run regularly in the Hamburg-New York route, making the trip across in about eleven days. As this is the greatest freight carrier afloat, it is of interest to compare her dimensions with those of the Great Eastern, the leviathan whose gigantic appearance, as she entered New York harbor, nearly forty years ago, is well remembered by many.

In reporting to the Secretary of War upon the necessity for a deeper entrance to New York harbor, Col. G. L. Gillespie, of the Engineer corps, urges the construction of a 35-ft. channel at low water. The present channel has a depth of 30 ft. at mean low water, but the continual increase in the draught of ocean-going vessels has caused a pressing demand for further dredging. On the first voyage of the Pennsylvania she drew $31\frac{1}{2}$ ft. The widening of the channel is also necessary on account of the increased lengths of the newer vessels. The estimates for the work of deepening the channel to 35 ft. and increasing the width are: 1,000 ft., \$1,740,000; 1,500 ft., \$2,772,000; 2,000 ft., \$4,180,000

HIGH STEAM PRESSURES ON SEA GOING SHIPS AND IN GENERAL.—I.

BY DR. R. H. THURSTON.

Continuous rise of steam-pressure has been a notable feature of progress in the marine department of steam engineering from its earliest days. This fact is in itself sufficient proof that this is at least one of the most important, if not the most essential, element of advance; and it requires no knowledge of the science of thermodynamics to convince one familiar with the practical side of this movement that increasing steam-pressure means improving economy, up to some limit as yet unknown. That there is such a limit is sufficiently obvious from the fact that, throughout this history of the marine engine, gains have been continually less and less rapid, proportionally to the rise of pressure. It may also be inferred from the general principle that the nearer the engineer approaches the perfection of his ideal, the more difficult does it invariably become to effect additional gains, and, the narrower the margin between the fact of the moment and the "theoretical" limit, the slower the progress made in effacing that margin. Thus we have, in the following data, illustrations of the method and rate of progress of the marine engine since the beginning of the century, the date of its practical origin.¹

Until the introduction of the compound marine engine, the advance in pressures and expansion

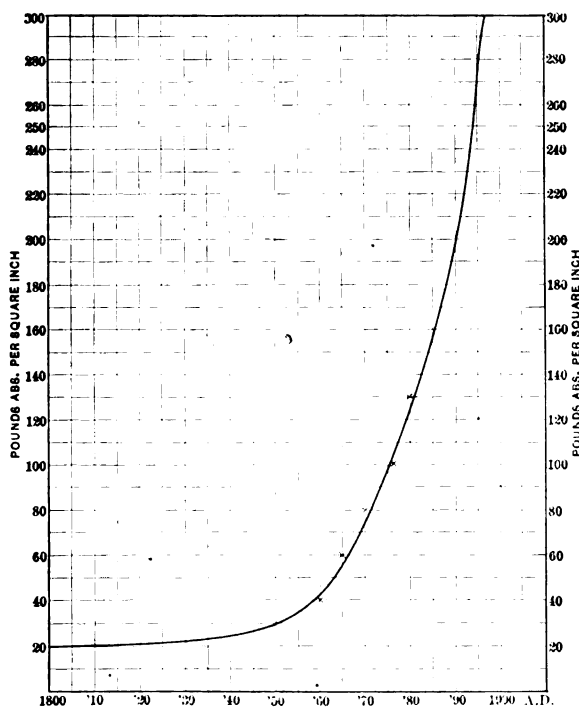


FIG. 1.—RISE IN STEAM PRESSURES, 1800-1900.
Marine Engineering

¹ Vide History of the Growth of the Steam-Engine; 4th ed., 1897, pp. 482, *et seq.*; and Manual of the Steam-Engine, ed. of 1896, Vol. I, pp. 76, *et seq.*

was slow; but from 1850 the progress is seen to have been not only rapid, but quite as remarkably and continuously accelerated in its rate of gain.² At the present time the indications seem to be that, for some cause, probably connected with the difficulties in securing satisfactory boiler construction, this rate of acceleration is beginning to fall off. The maximum pressures rise from fifty pounds a generation ago to 125 pounds in 1880, to 200 pounds in 1890, to 250 in 1895, and are likely to be about 300 pounds in 1900. The change now taking place, in the transfer of the work of steam-making from the shell-boiler to the water tube boiler, seems likely soon to result in the removal of many obstacles, and it is very possible, that in the near future it will be found easy to control and utilize pressures of 500 and of 1,000 pounds per square inch. In fact, the employment of 1,000, 1,500, and, as is said, 2,000 pounds pressure by Jacob Perkins sixty years ago and of 800 and of 1,000 pounds by Dr. Alban, a half century ago, may be taken as ample evidence of the practicability of employing such tensions of steam if found desirable.³ The two real questions are: Will it pay the boiler-maker to supply boilers for these pressures? and will it pay the engineer or steam-user to adopt them in ordinary practice? These are questions to be settled by experiment and experience. A triple-expansion engine, with ratios of expansion in each cylinder of about $3\frac{1}{2}$, will work steam of 500 pounds, and at 4 to $4\frac{1}{2}$ expansions will take care of steam at 1,000 pounds. A quadruple-expansion engine will similarly handle 500 and 1,000 pounds with ratios of 2 and $2\frac{1}{2}$.

With this steady rise of steam-pressures has been observed as constant increase in the value of the ratio of expansion adopted in the most successful practice. One of the most interesting, instructive, and remarkable facts in the history of the marine engine, as of other types, is the singular moderation of builders in following the principle enunciated by Watt in his patent of 1782, that of economical expansion of steam. Purely thermodynamic and purely mechanical theory dictated a ratio nearly equal to the quotient of back-pressure divided by initial pressure; but, even after the introduction of the multiple-cylinder engine, doing away, largely, with the difficulties arising from irregular impulse and consequent variable motion of the crank, all designers and builders recognized the existence of a limit far inside this of the ideal case. But it was only after the nature, extent, and effects of the internal wastes by "cylinder condensation" had been clearly shown, by Clark, Hirn, and Isherwood and their successors, that the real meaning of the known ineffectiveness of expansion beyond a very restricted limit became familiar to the profession of engineering.

² Trans. A. S. M. E.; Vol. xv., 1893; lxxii., p. 354.

³ "History of the Growth of the Steam Engine," pp. 323-327. Vide also Stewart and Galloway's Histories, and Fole's translation of Alban.

Steam in the engine, when subject to the influences characteristic of the ordinary steam-engine construction, behaves very differently from its assumed method of action in the ideal case.

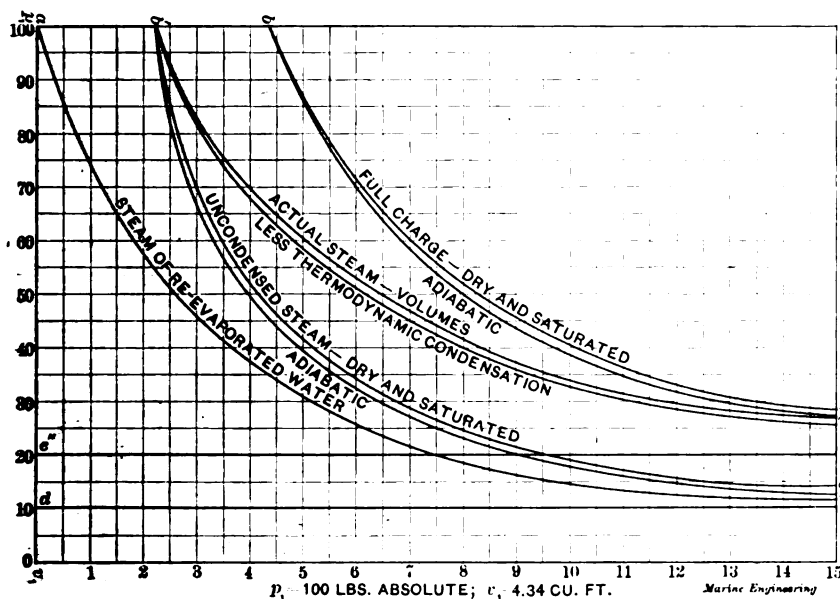


FIG. 2.—1 LB. STEAM IN THE STEAM ENGINE.—RANKINE CYCLE.

This fact may be perhaps best shown, in a general way, by the accompanying diagram of the action of one pound of steam entering the engine at 100 pounds absolute pressure, and in the dry and saturated condition. Its volume, at entrance, is 4.34 cubic feet and its temperature 327.6° F. If expanded from its initial and minimum volume and retained, meantime, dry and saturated, its successive volumes, at successive pressures and temperatures, will be given by the steam-tables, and its expansion-line will be $b c$; while the adiabatic will be slightly lower, and as on the diagram, $b' c'$; the difference being due to the progressive condensation of the steam expanding and doing work, to thermodynamic condensation.

In the actual engine, however, the steam entering is partly condensed; and, often, in the simple engine with high ratios of expansion one-half may be found, as in the diagram, to be thus reduced to the liquid state. The remaining steam, if expanded as assumed for the full charge, in the preceding case, would give the curve of constant weight, $b' e$, or, if adiabatically expanded, the line $b' e'$; thermodynamic condensation producing loss of pressure continuously. But this does not occur. The water of condensation at entrance commences re-evaporating from the moment of closing of the cut-off valve, and this produces wet steam continuously; the mixture of this liquid and its vapor thus producing a volume continuously increasing, as along the line ae , of the diagram. It often happens that practically all of the water of "cylinder condensation" is thus re-evaporated before the end of the stroke

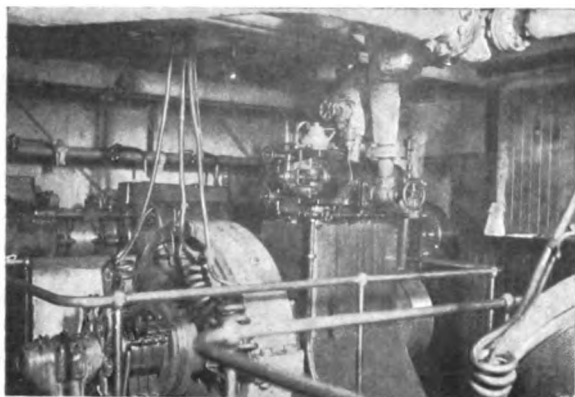
of the piston is reached. In such case, the addition of the steam thus produced to that left uncondensed, at the moment of cut-off, gives the line $b' c$, if thermodynamic condensation is not taken into account. Such condensation does, however, occur in every case, and whatever the circumstances under which heat-exchanges take place, and to the amount of, approximately, a percentage measured by the ratio of expansion, as shown by the line $b' e'$; though in the case here illustrated, perhaps entirely obscured in its effects by the heat-interchanges observed between the fluid and the metal of the cylinder-wall or the water accompanying the steam when not initially dry.

The ideal engine-diagram differs thus from the real, in often a very remarkable and striking manner, and the corresponding differences of work performed per unit weight of working fluid are similarly disclosed by comparison of the areas, enclosed between these expansion-lines and the base-line, $e e''$ or $e' d$, usual fair terminal pressure lines, respectively for non-condensing and for condensing engines of good performance. It is this internal form of heat-waste that has constituted the main obstacle to advance in the improvement of the economical action of the steam engine, and which has impeded approximation to its thermodynamic perfection.

A contract has been let by the Spanish Government for a floating dock to be moored at the port of Olongapo in the Philippine Islands. The dock will be the largest of its kind and will measure 450 ft. in length, 117 ft. in width over pontoons and 38 ft. 6 in. in depth. The dock when in position will rest on six pontoons, each about 14 ft. deep. These will be of iron while the sides of the dock will be of steel. The pontoons will be so arranged that should any one be damaged it can easily be removed and floated onto the dock for repairs. Powerful pumping engines will be fitted so that a vessel weighing 12,000 tons can be lifted in about two hours. The maximum length of vessel which the dock will accommodate will be 500 ft. The dock will be built in sections, so that it can be readily shipped to its destination from the yard of the contractors, Robert Stephenson & Co., at Newcastle-on-Tyne, England.

ELECTRICITY ON S. S. LA GRANDE DUCHESSE.

Electricity is such a necessity aboard ship that now every steam vessel, for whatever purpose designed, is fitted with, at least, an electric lighting plant. From a beginning made in the lighting



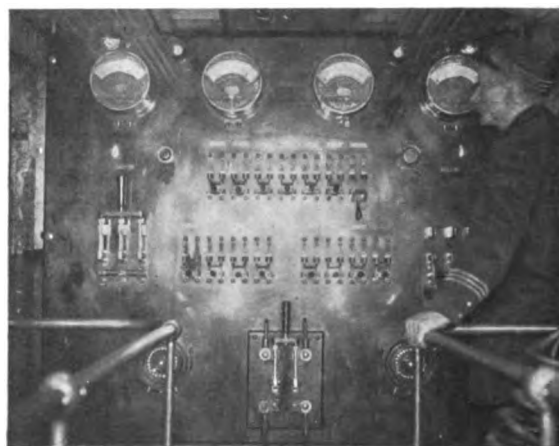
STARBOARD SIDE OF DYNAMO ROOM.

of engine rooms and cabins, the applications of electrical energy have been extended to a great variety of practical uses. As complete an installation as can be found in a merchant vessel is that which the new Plant liner, La Grande Duchesse, is equipped. In this steamship electricity is used for seven separate and distinct purposes.

The plant is located in a separate compartment aft of the engine room, between the thrust bearings. Entrance is had from the engine room through two water-tight doors, opposite to which in the after bulkhead are corresponding doors leading into the shaft tunnels. In the center of the compartment on either side of the keel-line the duplicate generators and engines are placed in a fore and aft position. They are of the 20 K.W. direct-connected General Electric marine type. These engines have high-pressure cylinders 7 by 7 in. and cranks set opposite. Steam from the main boilers is reduced at the engines to 140 pounds, which gives 550 revolutions a minute. The generators are connected into a marbelized slate switchboard bolted to a frame about 12 in. from the engine room bulkhead. This is a little over 5 ft. square, in one piece, is 2 in. thick and weighs 1,200 lbs. The fittings which are shown in the accompanying cut include two main dynamo switches, fifteen feeder switches, one motor switch, one three-point volt-meter switch, one volt-meter, and three ammeters. Two of these are for the generators and one for the search-light circuit. There is also on the board one ground detector and two Carpenter enamel field rheostats. For purposes of observation, two single incandescent light brackets illuminate the instruments. Overhead in the center line of the board the rheostat for the projector is bolted to the deck beams. Of the sixteen circuits controlled by the board switches, ten

go to as many distributing points for general lighting on the two-wire 110-volt system, using Edison lamps. These distributing boards are located at convenient points on the various decks. The boards are made of blue Vermont marble and are enclosed in cabinets made of wood to correspond with the surrounding joiner work. The wiring from these centers, which is arranged so as to have not more than eight lights on each circuit, is run in hardwood moldings. The staterooms have one light each with the lamp switch at the head of the berth. The other feeders from the switchboard are used; one for the search light; three for the cargo circuits; one for the running lights, and one for the two 12 K.W. motors operating the coal-trimming apparatus. The ship has a total of 700 incandescent lights and one arc light. The arc light is fitted with a 12-in. projector in position on the foremast just above the pilot house.

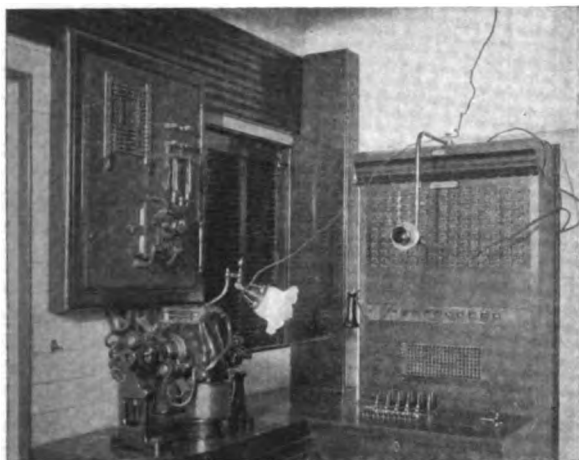
Inside the pilot house there is a variety of electrical apparatus. Instead of having the wheel connected directly with a steering engine under the wheel house, the steering engine is placed aft in the tiller room and operated by a telemotor controlled from the pilot house. A brass column in front of the steersman carries a wheel of the usual pattern, and an indicator on top shows the exact angle to which the engine should bring the rudder when the wheel is turned. The connection between the controller and telemotor is made with a 26 conductor. This does away with the noise and inconvenience of rods or chains and keeps the mechanical steering gear in compact form in the rudder room. The telemotor instantaneously following the motion of the hand wheel regulates, through suitable gear, the admission of steam to the proper ends of the steering engine cylinders. To the left of the steersman,



GENERAL VIEW OF SWITCH BOARD.

on the wall of the house, there is an electrical rudder indicator which is wired to a sliding contact on the rudder quadrant, so the exact position of the rudder can be read by a glance at the dial. Incandescent lamps fixed in sockets on the sides and roof of the house, corresponding

with the positions of the running lights, are so wired that should any of the running lights go out, the corresponding lamp would be switched in, and a buzzer at the same instant sound a



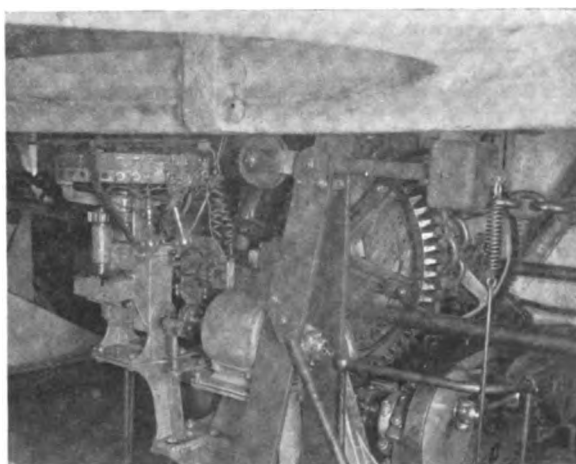
TELEPHONE EXCHANGE ON MAIN DECK.

warning. There is also an annunciator in the house connected with the thermostats at fourteen different points in the cargo spaces, forming a very complete automatic fire alarm system. More novel and useful perhaps is a complete telephone exchange with a central station and 150 instruments, giving instant communication between all parts of the ship. The exchange, a view of which is given, is situated on the starboard side of the main deck cabins, where an operator is always on duty. In each executive officer's cabin and in each state room a compact instrument of the Bell long-distance pattern is fitted to the side. In the state rooms the telephone is placed close to the head of the berth, and the passenger, if in his berth, can call "central" by a push button, and unhook the receiver without rising. Five connections can be made at one time through "central." The necessary current is obtained from storage batteries, taking current at 8 volts from a rotary transformer, shown in the cut, which is connected with the lighting circuit.

There is also a novelty aboard in the electrically driven coal trimming apparatus. The bunkers are fitted athwartship fore and aft of the boiler room. Two gratings are fitted in the 'tween deck on each side of each bunker close to the loading ports in the sides. There are, consequently, eight openings into the bunkers through which coal can be loaded, each 20 by 27 in. fitted with three crossbars about 7 in. apart. This is sufficient to prevent the passage of too large lumps of coal into the conveyors underneath. These run across the top of the bunkers parallel to the bulkheads and each other. In each conveyor an endless sprocket chain carries scrapers 16 in. wide, 18 in. deep and 30 in. apart. In the under sides of the conveyors there are a series of slides, each of which is opened and

shut by a rack and pinion worked by a hand wheel below. The driving shafts of the conveyors are on the starboard side and are carried through the bulkheads into the boiler room. There are two 12 K. W. motors connected to the shaft ends by reducing gears in the ratio of twenty to one. The motors are overhead in the boiler room close to the bulkheads. With the gears they are enclosed in dust-proof casings, which are provided with doors. The coal is brought alongside in barges and dumped into chutes in the usual way, which discharge over the bunker gratings. The direction in which the motors run is governed, of course, by the side of the vessel in which coal is being loaded, and using each series of conveyors oppositely, coaling could proceed from both sides at once. A handy switch permits of instant reversal of motion. Since the vessel commenced running, this apparatus has worked perfectly. One man only is necessary to operate the slides in the conveyors so that the coal shall be evenly distributed over the bunkers. When the bunkers are nearly full, it is necessary to put four or five men to work for about an hour to level off the various mounds which have been formed under the conveyors. The full capacity of the automatic trimmers has never been tested as the maximum rate of loading is regulated by the speed at which the buckets can be filled in the barges alongside. This is far below the capacity of the conveyors. Loading from one side alone the average rate for the 500 tons taken aboard, is about one ton a minute.

The greater part of the electrical equipment of the liner was manufactured by the General Electric Co. in its Schenectady shops. The electrical steering apparatus was supplied by the William-



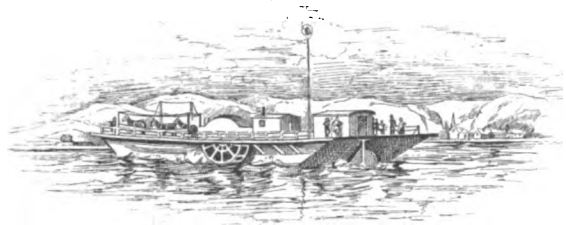
TELEMOTOR ATTACHED TO STEERING ENGINE.

son Brothers, of Philadelphia, and the telephones by the Bell Co. All this apparatus was fitted aboard in the builder's yard at Newport News, under the supervision of C. H. Richardson, superintendent of the electrical department of the Newport News Shipbuilding and Dry Dock Co.

ORIGIN AND DEVELOPMENT OF THE FERRYBOAT.—I.

BY A. E. STEVENS.

There is no other city of the commercial importance of New York so bounded by navigable streams. From their physical characteristics, civil engineering was not able to supply crossings



TEAM BOAT OF EARLY TIMES.

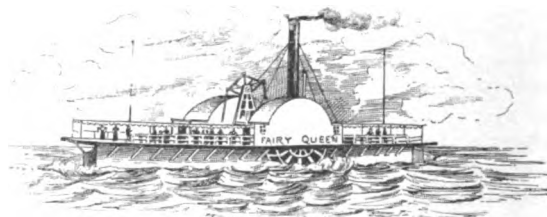
in the way of bridges or tunnels until long after the demands of travel had necessitated some more modern means of transit than the rowboat, or the periauger of our forefathers. The successful application of steam in navigation took place in that harbor in which nature had made the greatest local demands for such an improvement; and it is to the combination of such demand and the ability to meet it, accidental or otherwise, that New York owes the honor of being the birthplace of marine engineering. Though the birthplace of the science has lost the position of leadership in marine practice, there can be no question but that in the specialty of ferryboats New York still remains pre-eminent. A glance at the amount of ferry business done on the North and East Rivers and across the waters of the Upper Bay, suggests the causes of this result. It is estimated that every year the ferries between New York and New Jersey alone carry a total of passengers somewhat greater than the total population of the United States. The yearly ferry business of the harbor is probably not less than 200,000,000 passengers, and 6,000,000 teams. All of this is carried with remarkable safety, and upon vessels which are as a class far superior to any engaged in similar traffic on any other waters. New York, therefore, is the best place in which to study the question of ferryboats.

Many of the older ferries antedated the era of steam, and are still operated over the same routes on which the periauger and rowboat carried the colonial farmers of New Jersey and Long Island to their markets on Manhattan Island. Following these, soon came the team boat, or horse boat, in which the muscular power of horses and mules was used for the propulsion of the vessel. They were either double hulled vessels, with a radial paddle wheel between the hulls, or of the scow type, with wheels on each side, as shown in the illustration.

In 1812, two steam boats, designed by Robert Fulton, were placed in use upon the Paulus

Hook ferry, from the foot of Cortlandt street, and one by Colonel John Stevens upon the Hoboken Ferry, from the foot of Barclay street in New York. The latter boat, the little Juliana, was afterwards withdrawn from the service, and, as then announced, in favor of the "more convenient" horse boat. It is almost certain, however, that this retrograde step was taken because of the monopoly enjoyed by Messrs. Fulton and Livingston for the navigation of the waters of the State of New York with steam. Fulton's boats had twin hulls, and measured about eighty feet in length. Several of this type were also built for use on the East River, but they did not prove successful. In 1822-1823, the Hoboken Ferry returned to steam propulsion; and the boats then adopted may be regarded as the direct forerunners of the vast majority of American ferryboats. Little information survives as to the build of the Hoboken and Pioneer, the boats with which the service was begun. Their immediate successor, the Fairy Queen, which went into the service in 1828, has had her memory preserved in the sketch which is here reproduced. Her cost was \$16,874.50. These boats had their cabins below deck, and the teams stood on the open deck. They could carry comfortably not more than one hundred persons and six to eight teams. A drinking bar was a feature, and in summer an awning, shown in the illustration of the Fairy Queen, was spread over the deck. The steering was by a tiller, which was shifted from end to end. The pilots stood forward and passed the word aft to the helmsman. The engines of these boats were sufficient to give them, for their day, a very high speed. They did not differ from the beam engines of to-day in any of the essentials of design. The wooden side-wheels of that day have survived in some of the modern boats.

By small changes the beam engine boat of to-day, as illustrated by the Montclair, has been evolved. In other directions, scattered attempts to introduce the inclined, instead of the beam engine, and discussion of the advisability of other types, were about the only symptoms of advance,

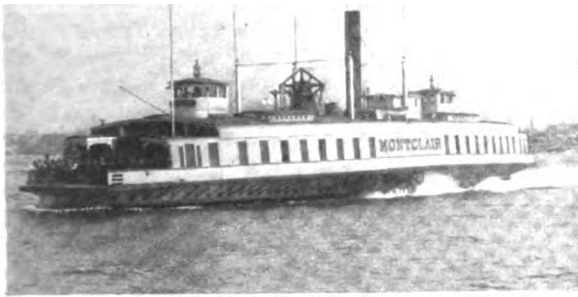


ORIGINAL TYPE BEAM ENGINE FERRY.

until the construction of the Robert Garrett and Erastus Wiman for the Staten Island ferries. In these, a compound inclined engine and feathering side wheels were introduced in place of the beam engine. The vessels themselves were large and powerful, but their type has never been

reproduced. Compound engines had also been tried on the Fishkill, in a curious combination of a steeple compound with Corliss valve gear, driving the ordinary beam. The boat was built for the ferry between Newburg and Fishkill in 1884. This type also has never been reproduced. Special conditions and needs in different places, led to widely different types in the ferryboat by the natural process of evolution, but on routes where conditions have remained unchanged early forms survive.

For example the heavy ice on the Straits of Mackinaw has produced such ice fighters as the St. Ignace and St. Marie, while though the horse boat has passed away, the rope ferry survives as a costless form of motive power, and the row or sail boat is still among the successful ferries of the day. In addition to changes in form, due to physical characteristics of the route and the amount of travel over them, different classes



MODERN SINGLE DECK FERRYBOAT.

of travel have produced different types of boats; as for instance, the powerful ferry steamers plying between Detroit and Windsor, and San Francisco and Oakland. In the former, like most examples of naval architecture on the lakes, an originality and desire for improvement is displayed characteristic of their western origin. Designed to ferry trains of cars, they are, of course, of quite a different type from the ordinary passenger ferryboat. Their most marked difference lies in their motive power, which consists of horizontal engines running at high speed and placed below deck, driving the sidewheels through pinions and gears. The wheels are capable of working independently, and give the boats great maneuvering power, but the rattle of the gear would be inadmissible in ordinary passenger service. A similar service is performed in New York harbor from Mott Haven to the New Jersey shore, on the ferryboats Maryland and Express.

Probably the earliest demonstration of the practicability of screw propulsion was made in a small model (now preserved in the Smithsonian Institution in Washington) which in 1804

and 1805 was tried by Colonel John Stevens, of Hoboken. While the boat was simply an experiment in steam propulsion, she demonstrated, at that time, the practicability of the use of screws. It is curious that many of the experiments were made between Barclay street, New York, and the ferry landing at Hoboken, although the boat could in no sense be called a ferryboat. Screw propulsion at that time was abandoned because the route to Albany, which early New York designers had in view, did not allow sufficient draft to accommodate the diameter of the propellers which experiment showed to be necessary with the slow engine speed of the time.

In the fifties, Colonel Stevens' sons designed, and actually contracted for the construction of a screw ferryboat, whose mutilated model is still in the possession of the writer. For some reason, however, the vessel was never built, and the subject remained in abeyance until in 1867 Livingston Brady, of New York, patented a system of screw propulsion for ferryboats. Two vessels were subsequently built for use on the Mississippi River. While accounts agree that they were otherwise satisfactory, the wash caused by the race from their propellers proved so destructive to levees that their use had to be abandoned. These vessels were afterwards used as agitating dredges in the Mississippi passes.

There is now building in Belfast for the White Star Line an addition to its transatlantic fleet which in size and power considerably exceeds any vessel afloat or building. This new liner is to be called the *Oceanic*, a name which was very worthily borne by one of the first steamships of the company, now withdrawn from service. The *Oceanic* will be 685 ft. between perpendiculars, 704 ft. over all and between 17,000 and 18,000 tons gross register. She will be fitted with twin screws, and will, in general, follow the lines and equipment of the present *Majestic* and *Teutonic*. It had been known for a long time that the company had in contemplation the construction of a monster passenger boat and the lack of detail caused many exaggerations to be circulated about the speed which she would have. Even 27 knots was said to be within the limit. The *Oceanic* will probably be fitted with more powerful engines than any other liner in existence, but according to the most authentic reports, the question of speed will be subordinated to the comfort and convenience of passengers, of all classes. The *Oceanic* will be fitted as a mercantile armed cruiser.

Traffic returns of the Manchester Ship Canal for 1896 give a total tonnage of 1,509,659 tons, a substantial increase over the previous years. The total for 1895 was 1,087,443 tons and for 1894, 682,600 tons.

INCREASING SIZE OF LAKE STEAMERS.

Marine architects find the increasing size of the steamships which ply on the Great Lakes a subject of perennial interest. In the early days of steam navigation a vessel of 780 tons was called "big." Half a century was required for the limit in size to climb to 2,500 tons. In 1891, 300 ft. keel, 40 ft. beam and 24 ft. in depth were the dimensions of the largest vessels. Since that time the increase in size has been remarkably rapid. The length of keel has been increased from 300 ft. to 400; the breadth of beam from 40 ft. to 48; the depth from 24 ft. to 28; the tonnage from 2,500 to 4,500. Even this by no means sets the bounds for the shipbuilders. No less an authority than W. I. Babcock of the Chicago Shipbuilding Company predicts that vessels 500 ft. long with a capacity of 6,000 tons will soon be built, and this, too, regardless of any prospective increase in the depth of water in harbors and channels. Mr. Babcock thinks shipbuilders will be content to stop at the 6,000 ton limit for some time to come, even with the twenty foot waterway to the sea. Just to show what the navigators of the Great Lakes have to contend with a few figures taken from government reports on the depth of water at some of the principal harbors may be of interest.

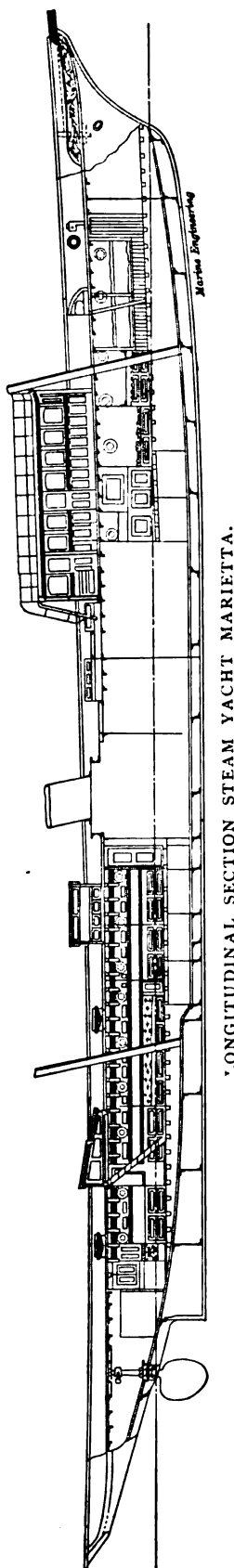
The entrance channel to Chicago harbor has been dredged to a depth of 20 ft. though at the entrance to the river the depth is but 18 ft. Over the La Salle street tunnel, a short distance from the mouth of the Chicago river, there is but 16 ft. of water. Only a small part of the river has over 15 ft. of water. At Duluth a depth of 13 ft. is maintained at the canal entrance. In the greater portion of the harbor basin the depth is 16 ft. At St. Joseph and Benton harbor the available depth in harbor and canal is 12 ft. At Buffalo vessels drawing 23 ft. can enter the outer harbor. Buffalo river and Blackwell canal allow a draught of 16 ft. At Calumet (South Chicago) 12 miles from Chicago, a depth of 16 ft. is maintained. The Illinois Steel Company's basin has a depth of 19 ft. At Cleveland the depth in various parts of the harbor ranges from 17 to 20 ft. At Erie the depth is 18 ft. at mean lake level or not less than 16½ ft. at low water. At Grand Haven, the principal harbor of refuge on the east coast of Lake Michigan, the depth is 18 ft. At Manitowoc 15½ ft. At Milwaukee the channel between piers at the entrance to the river affords a depth of 19 ft. The average depth of water in the river is 16 ft. The Sault Ste. Marie canal has a depth of 21.5 ft. The Detroit river has a number of shoal spots where there is but 17 ft. of water. The work of dredging a 21 ft. channel through the river will soon be completed. Before the close of the present season an 18 ft. waterway between Duluth, Chicago and Buffalo will be completed.

There has been a vast amount of talk about the Chicago drainage canal having a

disastrous effect in lowering the lake levels. The consensus of opinion among the best engineers is that they do not know anything about it and that they will not know until the channel is in use. They are inclined to believe that the lowering in level will be too slight to be of any consequence. Judging by the vast amount of money recently invested in vessels of large size no apprehension that the lakes will be drained by the channel exists. Statistics show more vessels of large size on the Great Lakes than on the Atlantic coast. Of the 3,333 vessels of all kinds aggregating 1,324,068 gross tons, on the lakes, 383 are of 1,000 tons or over, while on the Atlantic coast out of the 16,786 vessels of all kinds aggregating 2,667,314 tons, but 247 are of 1,000 tons or over. Bringing the comparison right up to date it is found that the lake shipyards are still gaining on the Atlantic coast builders; for in the three months ending with the year 1896 three new steel vessels were registered on the lakes with an aggregate gross tonnage of 13,890.30, against four steel steamers on the Atlantic coast with an aggregate gross tonnage of 9,442.76. More steel vessels were built on the Great Lakes last year than in all the rest of the country together. Vesselmen agree that the larger boats are to be the controlling factor in lake navigation in future. One-third of the general traffic in coal, grain and iron ore this season will be done in modern vessels constructed to utilize the increased depth of water. By the opening of navigation there will be 20 ft. of water to all the elevators in South Chicago. Even cities as small as Manitowoc are endeavoring to secure a greater depth of water in their harbors in order to retain their share of lake commerce. Chicago business men fear the larger vessels may cease frequenting their harbor and transfer their business to South Chicago, hence the movement to have the tunnels under the river lowered has a great deal of energy behind it.

Experimental tests with the sand blast in cleaning ships' bottoms are being made at the navy yard in Brooklyn, N. Y. The preliminary test was upon the hull of U. S. S. Atlanta. This was entirely satisfactory. With a pressure not to exceed 15 pounds, the blast swept away all incrustations with great rapidity. The nozzle, attached to a length of flexible pipe, was readily moved along the skin, leaving the plates clean and highly burnished. The apparatus is very compact. A small compressor supplies the blast, which is conveyed in iron pipes along the dock coping. At convenient intervals there are connections to which the piping leading down into the dock can be attached. Sharp sand is admitted to an attachment at the nozzle of the hose. The time occupied by this process compared with the ordinary method of scraping is said to be five times as fast. The process has been in use in foreign navies for some time.

STEAM YACHT FOR HARRISON B. MOORE.



There was launched at the yard of the John N. Robins Co. at Erie Basin, Brooklyn, N. Y., March 27, a steel steam yacht for Harrison B. Moore, which will probably prove to be one of the fastest pleasure crafts in Eastern waters. The designer, Mr. Henry J. Gielow, has aimed to produce a vessel in which the interior accommodations would be ample, and a high rate of speed for cruising could be economically maintained.

Particular care has been taken in the selection of material and construction to produce a thoroughly staunch, seaworthy and yet speedy craft. The hull is of mild steel, having a tensile strength of from 55,000 to 60,000 lbs. per sq. in. and an elongation of not less than 25 per cent. in 8 in. The dimensions are: Length, 172 ft. 6 in., over all; 140 ft., load water line; beam, 18 ft.; depth 10 ft. The mean draught with full equipment and stores aboard is 7 ft. 9 in. Carrying out the idea of safety, a double bottom has been built amidship which will be utilized for fresh water tanks, or for water ballast in a seaway. There are four steel water tight bulkheads, so placed that the yacht would float even with two compartments filled. The lines are very graceful, tapering sharply forward, and there is a handsome clipper bow and considerable overhang at

the stern. There are two masts and one funnel, with a considerable rake, making altogether a very smart looking vessel. The deck is flush from stem to taffrail, and none of the deck fittings will show above the bulwarks except the deck house. This is 26 ft. long and rises 5 ft. 8 in. above the deck. The roof is level and is reached from below by a ladder with brass rail, which also runs around the top of the house. This makes a very convenient platform for observation in fine weather. In the forward end of this house the social hall is situated, and back of this is the butler's pantry, fitted with a dumb waiter connecting with the galley below. In the after end the captain's state room is furnished in comfortable style, and has in it a chart rack and desk. The crew's quarters are forward on the main deck. They are very roomy and conveniently fitted up. Aft of this is the ward room and officer's rooms and then the galley. Next come the engine and boiler rooms taking up 33 ft. along the keel line and the width of the hull. An air space about a foot wide aft of the engine room bulkhead, prevents the radiation of any heat from the machinery spaces into the state rooms. The saloon is 15 by 17 ft. fitted with two sideboards and four sofas, these arranged so that they can be readily converted into berths and by means of curtains the saloon can be divided into four separate compartments. There are five staterooms, four forward of the saloon, and one aft which takes up the entire width of the vessel. There are also two wing berths in the after end of the saloon. Every room has both hot and cold running water. Polished mahogany is used for the interior joiner work and the decoration is in white and gold. Lighting throughout will be by electricity, the plant consisting of a generator and a storage battery.

The propelling engine is of the four cylinder triple expansion type, with cylinders 14 in., 21½ in., and two 24 in. dia. by 18 in. stroke. The bed-plate is of steel, and all the moving parts are of steel as light as is consistent with strength and durability, the bearings and pins having extra large wearing surfaces. Piston valves are used throughout. The estimated I. H. P. is 1,000 at 300 revolutions and a boiler pressure of 250 lbs. Copper is used for the condenser shell for lightness. This has eight hundred ¾ in. tubes. A rotary engine operates the circulating pump. Steam is generated in two Roberts water tube boilers, placed side by side aft of the engines, the line shaft running between. The rough dimensions of the boilers are width, 6 ft. 3 in.; length 9 ft. 9 in. and height 6 ft. 8 in. The grate area is 80 sq. ft. and the heating surface is 2,640 sq. ft. Forced draught on the closed fire room system is produced by a blower coupled to a twin cylinder high speed engine. The yacht will be known as the "Marietta," and will be commissioned about May 30 next.

NEW DOCK AT N. Y. NAVY YARD COMPLETED.

New Timber Dry Dock No. 3 in the Navy Yard at Brooklyn, N. Y., was tested March 17 by the docking of the Monitor "Puritan," 6,000 tons. This is the largest dock on the eastern seaboard, and in general dimensions the biggest anywhere on the coasts. Its construction was attended by many difficulties, natural and otherwise, not the least of which was the fact that the dock site is a quicksand. After the excavation had been made sheet piling, 8 in. thick, was driven around the space which was to form the bottom of the dock, also transversely under the

Dock No. 2. Connection is made with the new dock by two 42 in. pipes. The pumps have a capacity of 85,000 gals. a minute. There is also fitted for Dock No. 3 an independent drainage pump with a capacity of 7,000 gals. a minute. Tests made by the Government showed the leakage into the dock was very slight. A test of 49 hours showed less than a foot of water on the floor, which would give a rate of inflow of 6,800 gallons an hour. The total capacity of the dock at M.H.W. when filled is 15,605,000 gallons. Dock No. 3 is distant 150 ft. from the Simpson timber dock, officially known as No. 2, and is parallel with it. It will easily accommodate the largest

DOCK.	Length on Coping Head to outer gate.	Length on floor Head to outer gate sill.	Width of Entrance at Coping.	Width of Entrance at Bottom.	Depth over sill M.H.W.
No. 3 Brooklyn	668' 3"	624' 11"	105' 2 7/8"	71' 7 1/2"	29' 0"
No. 2 Brooklyn	500' 0"	459' 10"	85' 0"	52' 10 1/2"	25' 6"
Port Orchard	650' 0"	618' 6"	92' 7 3/8"	Inverted arch 66' 0"	30' 0"
Port Royal	495' 0"	459' 0"	97' 0"	66' 0"	26' 0"

DIMENSIONS OF DRY DOCKS IN U. S. NAVY YARDS.

floor, and also following the outer line of the cross cap system. Rough timber piles were freely used in getting a foundation, and under the floors concrete was laid, 4 ft. thick. Concrete was also extensively used in the abutments. The floor is built up of 12 by 12 in. longitudinal stringers secured to the tops of the foundation piles, upon which are secured 14 by 16 in. transverse floor timbers, spaced 4 ft. centers. Upon these timbers there is bolted the 3 in. working floor. The side or altar system is of 5 1/2 by 15 in. braces in pairs, embracing the pile heads in the side structure. The braces are notched to receive the 8 by 13 in. longitudinal timbers which form the altars or steps. These afford convenient ingress and egress to the dock at all points. A system of transverse cross caps secured to piles and to the tops of the altar braces, forms the stiffening construction outside the lines of coping and surrounds the entire dock. There are several transverse lines of sheet piling in the abutments as stopwaters. The sides are strengthened by tie rods, secured to anchor piles outside the cross cap system. Yellow pine is the timber used throughout, with the exception of the oak which occurs in the abutments. The whole structure is bolted and secured in a substantial manner. The necessity for this is apparent, when, for instance, it is remembered that the pressure against the edges of the caisson, when the dock is dry, is 28,000 pounds to the square foot. The dock is emptied by the centrifugal pumps which were put in for

ships in the navy and is long enough to hold two vessels, such as a battleship and a monitor, at the same time. The accompanying drawing shows

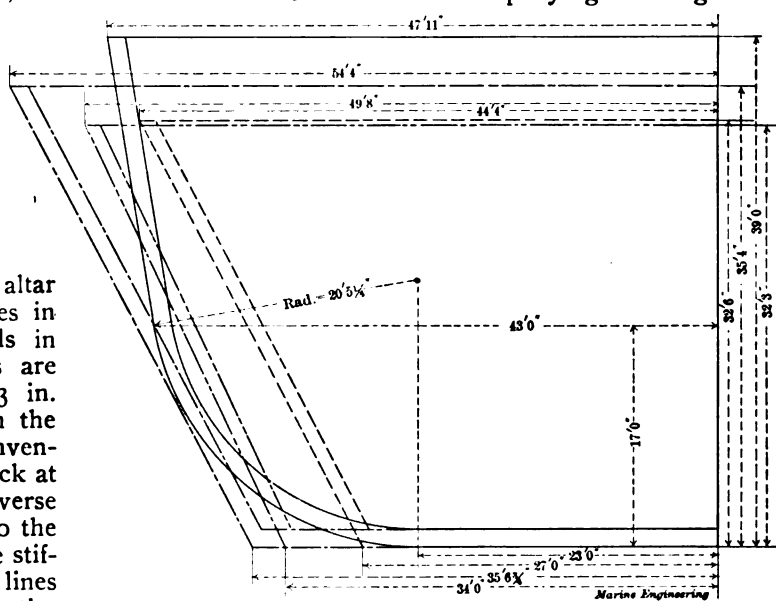


DIAGRAM SHOWING COMPARATIVE SIZE OF CAISSONS, U.S. DRY DOCKS.

NO. 3, BROOKLYN.

NO. 2, " AND DOCKS AT LEAGUE ISLAND—NORFOLK.

PORT ORCHARD, DOCK, PUGET SOUND.

PORT ROYAL, S. C.

SHOWN THUS:

"

"

"

"

graphically the comparative size over all of Caissons of six U. S. Dry Docks, including those of the three largest, viz.: Brooklyn dock, No. 3; Port Orchard dock in Puget Sound, and Port Royal dock, South Carolina; all of recent construction. The dimensions of these docks are given in the accompanying table.

The Brooklyn dock is by far the most important. Though it has a foot less water over the sill than the Port Orchard dock the depth is sufficient to take in, under normal conditions,

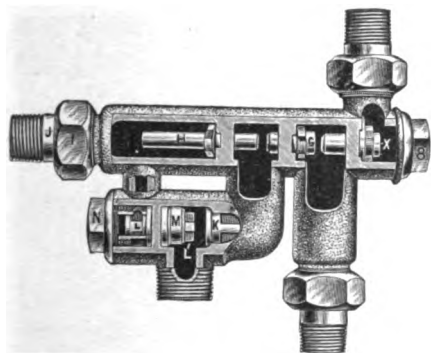
the largest ships in the navy now built or likely to be for a considerable time. Its strategic position as well as its situation on the eastern seaboard in easily navigable waters, and its close proximity to the splendid resources of the New York Navy Yard have all to be considered.

The plans for the dock were prepared by the Bureau of Yards and Docks of the Navy Department, now under the direction of Commodore Edmund O. Matthews, U. S. N. It was completed by T. and A. Walsh, contractors, of New York, the work being in charge of Engineer C. M. Bird, of Wilmington, Del., who has had much practical experience in the construction of government dry docks.

NEW APPARATUS.

A New Injector for Marine Use.

Among marine engineers the Penberthy Automatic Injector has obtained a wide reputation for its remarkable efficiency. The working range of this injector, however, has hitherto been limited to steam pressures of from 20 lbs. to 23 lbs. low up to 145 lbs. to 155 lbs. high, with an ability to handle hot water at 120 to 125 deg. at 60 lbs. to 80 lbs. steam pressure, and at 125 lbs. steam pressure, water at 95 to 100 deg. While these results have been satisfactory, the Penberthy Injector Company, Detroit, Mich., has realized for some time an increasing demand among marine engineers for an automatic injector which would



PENBERTHY SPECIAL INJECTOR.

work on higher steam pressures. It has made large numbers of the regular Penberthy Injector with special jets to work at 200 lbs., but in such cases the lowest pressure has been raised to 50 lbs. or 60 lbs. To get over this difficulty the company carried out a series of experiments which have resulted in the manufacture of the new Penberthy Special Injector. This has a working range of from 15 lbs. to 250 lbs. high steam pressure and will at the same time handle hot water at 140 to 145 deg. on 65 lbs. to 80 lbs. steam, 135 to 140 deg. at 100 lbs. steam, and 119 to 122 deg. at 150 lbs. steam.

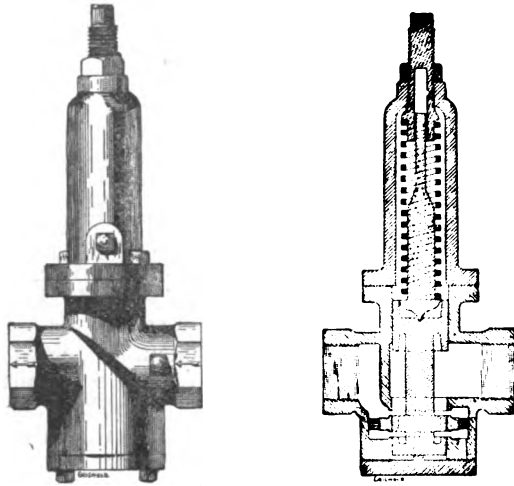
The reasons for the effectiveness of the new injector are thus explained by the company: In all automatic injectors heretofore made the vacuum valve, or overflow valve, K, will fall away from its seat the moment the vacuum at the points of the jets, G and H, is lost, which takes place as the temperature of the water increases at this point. With this injector, it will be noticed when the valves, L and K, are seated the end of the valve, L, comes against the end of the overflow valve, K, and the full boiler pressure being against the opposite end of the valve, L, the valve, K, is held firmly to its seat; thus accomplishing automatically that which in positive injectors requires two or three valves to be operated by the engineer. Again referring to the cut, the chamber in which the delivery jet, H, is located, is termed the pressure chamber, and in no other injector made is there an outlet from this chamber, except into the boiler. In the Penberthy Special there is an outlet around the valve, L, to the overflow. Therefore, in starting this injector, the only pressure to be overcome is the atmospheric pressure, the water passing through the jet, H, into the pressure chamber, and then out around the valve, L. This gradually closes as the current to the boiler is established, and the valve is thereafter held to its seat by the full pressure in the pressure chamber, referred to, which also acts through this valve upon the valve, K, as mentioned.

The Penberthy Injector Company fully guarantees this injector to do all that is claimed for it as above, and desires that every marine engineer should familiarize himself with the new method of construction and new principles involved. The company will send a full descriptive circular to any marine engineer on application.

Brass Reducing Valve.

A new reducing valve, put on the market by the Viaduct Brass Works, is shown in the cuts. This valve is designed to reduce and maintain whatever steam it may be adjusted to, regardless of the initial pressure, so long as this pressure does not fall below that to which the valve was adjusted. The valve consists of a valve cylinder with annular ports, and a piston valve fitted into it, which is so arranged as to open and close these ports, also leaving a confined space between the end of the cylinder and the lower end of the valve to receive the reduced pressure to operate it. By referring to the sectional view, it will be noticed that the high pressure enters through the induction pipe into the valve cylinder between the two pistons; and, the pistons being of the same diameter, it is powerless to move the valve until it passes through the annular ports to the outer chamber or low pressure side, and as soon as the low pressure that the valve is adjusted to is obtained, it will, by means of the small port leading from the low pressure side, communicating with the confined space below the valve at

the end of the cylinder, operate on the end of the piston valve, forcing it shut against the means for forcing it open. As soon as the pressure weakens, it also weakens on the end of the pis-



EXTERIOR AND SECTION OF VALVE.

ton valve, and the means for forcing the valve open will force it down and let in more supply to maintain the adjusted pressure. This valve is manufactured by the Viaduct Brass Works, 35 West Center street, Cleveland, O.

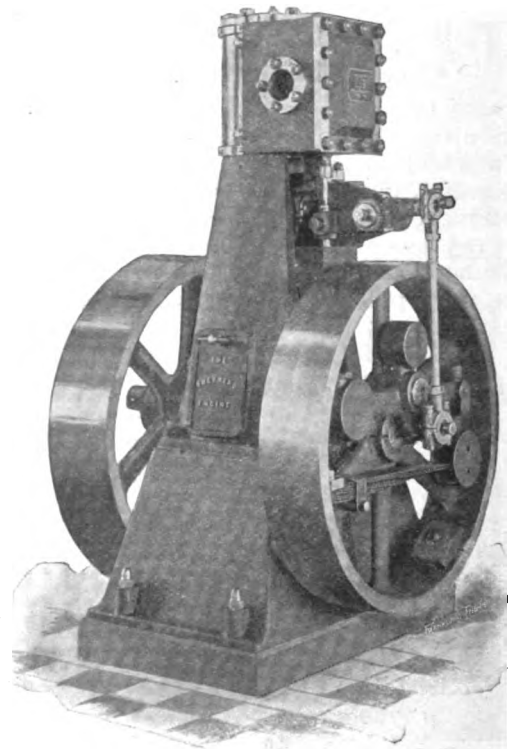
High Speed Vertical Engine.

The Shepherd vertical automatic engine, which is illustrated herewith, is designed especially for direct connection. The simplicity of design, the high speed at which it is capable of being run, the liberal wearing surfaces allowed, and the very small space a given power occupies, make it particularly useful for driving direct-connected generators for lighting, or for pumps, blowers, etc., on steamships, yachts, and ferry-boats. The engine is very clean and neat in operation; not a drop of oil is thrown about on the engine room floor or walls.

The bed and frames are of cast iron, well ribbed and braced, and contain within themselves the cross-head guides and the main bearings, thus making it impossible for the main working parts to get out of line except by wear, and adjustment for correcting this is provided. The back frame contains the guides and the rocker-arm bracket, and supports the cylinder should the front frame be removed. The cylinder and steam chest are cast together. The cylinder and barrel and both top and bottom heads are jacketed with an air space or non-conducting material. The valve is double ported for both steam and exhaust, and is self adjusting for steam tightness, automatically following up all wear. It is also collapsible and acts as a relief valve in case of water in the cylinder. The governor is of the Shepherd type, which gives remarkable results in the way of close re-ulation,

and combines simplicity, freedom from dirt (no oil being used about it in any way), and noise or pounding even after long use. The crank shaft is a solid steel forging, counterbalanced. The crank pin and main bearings are of very liberal proportions, and are automatically oiled by ring or chain oilers, which keep a continuous stream of oil running over them all the time. The piston rod, connecting rod, valve and eccentric rods, pins, bolts, are also steel forgings, accurately machined. The cross-head is of phosphor bronze or cast steel.

These engines are made in simple and compound types, the latter, both cross and tandem style, either for belted or direct connection, by the Davis-Farrar Co., of Erie, Pa., from the designs and under the personal supervision of Wm. G. Shepherd, the Vice-President and Manager.



SHEPHERD AUTOMATIC ENGINE.

The Davis-Farrar Co., and its Manager, have both had an extended experience in the design and construction of steam engines for marine uses.

Ornamental Radiators for Steamships.

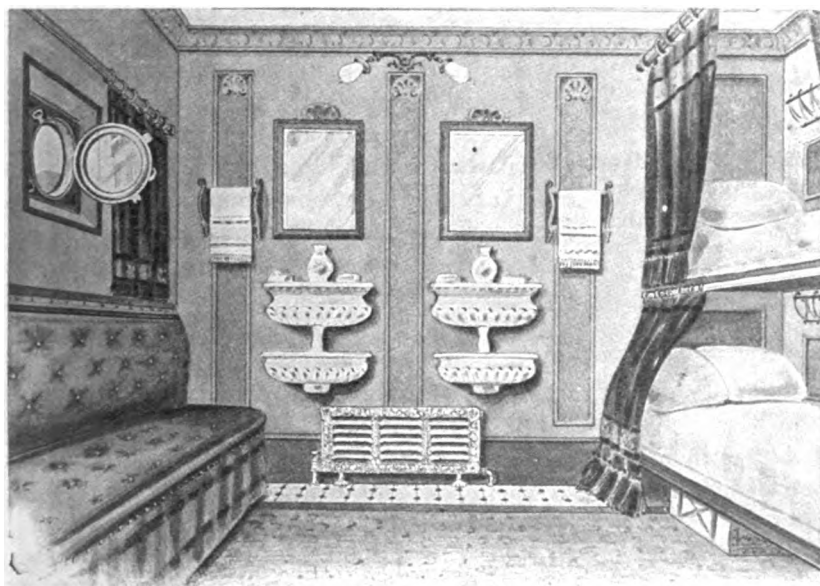
Improvements in the heating of staterooms and saloons of steamships has kept pace with the development in other conveniences. The coal stove of early days gave place to the steam coil of unsightly pipe. This was so out of keeping with the artistic interiors of modern boats that, while it was a practical success, it is being rapidly displaced by the neatly designed and compact radiator. The Fowler & Wolfe Manufacturing

Company, 391 Bourse Building, Philadelphia, Pa., has given much attention to what it terms ornamental wall and steamship radiators, and has recently completed installations on the steamships La Grande Duchesse and Creole and also on the pilot boat Sommers N. Smith.

The radiators are manufactured by the company in sections of two sizes, viz.: Standard size, $12\frac{1}{2}$ in. wide and 24 in. long, containing 7 sq. ft. of surface; and a smaller section, $12\frac{1}{2}$ in. wide and 17 in. long, containing 5 sq. ft. of surface. Both extend out from the wall $3\frac{1}{4}$ in., leaving ample air space behind. The larger section is sufficient to heat large outside staterooms, and the smaller size, inside rooms. For the saloons, cabins and larger rooms, these sections may be combined in a variety of forms and in any sizes required. The various forms and combinations of sections are fully shown in the new catalogue of the company. The radiators are made to withstand a pressure of 200 pounds to the square inch and more if required. They may, therefore, be safely used under high pressure direct from the boilers, if by accident the pressure reducer should fail to act. The company has orders in hand now for sets for four American steamships and for foreign vessels.

Bundy Trap for Marine Uses.

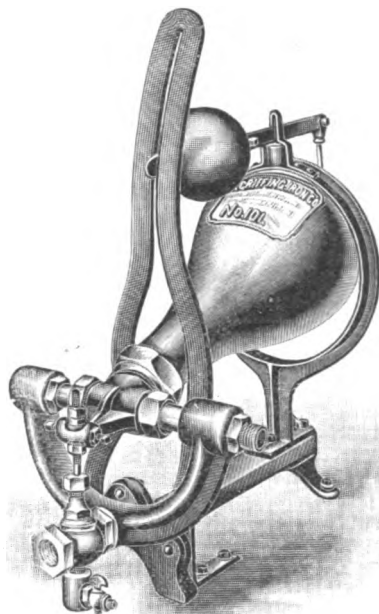
The wants of marine engineers, for simple and durable devices, are taken into account in the design of the Bundy Steam Trap. The illustration here shows a trap specially designed for use



CABIN INTERIOR SHOWING RADIATOR.

aboard ship. It operates through the weight of the water which flows into the pear-shaped bowl. As the large Bundy Traps hold from 40 to 60

gallons of water, this weight is considerable. By reference to the cut, it will be observed an arm is used to guide the lever while the ship is rolling, and another part is used over the ful-



EXTERIOR VIEW BUNDY TRAP.

crum of the lever to keep it in place. There is but one motion of the ship that can affect the working of the trap and that has been fully overcome, the manufacturers claim, by this device.

The Trap is made in two classes, viz.: The Return Trap and the Tank Trap. The Return Trap will return condensation to the boiler, or feed a boiler like a steam pump from a feed water heater. The Tank Trap will discharge the water into a tank or overboard. When the water has sufficiently filled the bowl it settles in the frame and discharges. After emptying, the ball weight on the lever raises the bowl. There are no interior working parts or any contracted opening, the full size being carried all the way through the trap. The Bundy Trap will raise water two feet for every pound of steam pressure carried. The manufacturers have issued a very com-

plete prospectus of this apparatus, which can be had on application to the A. A. Griffing Iron Co., 61 Centre street, New York.

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Communications on matters of interest to marine engineers, for insertion in the correspondence department, are solicited. These, wherever possible, should be supplemented by rough sketches or drawings, which will be reproduced if necessary to illustrate the subject, without cost to the writer.

Full names and addresses should be given, but publication of these will be withheld where requested.

Marine Engineering is the product of whatever carefulness and judgment the publishers possess, modified only by the difficulties incident to the construction of a technical journal. They believe there is a fairway for a publication that is designed to be accurate, absolutely impartial, and altogether devoted to American shipbuilding and engineering. The record of the trial trip is apparent. When the machinery shall have been in operation long enough to properly adjust the bearings better performance will be possible.

Several wealthy Americans have within a comparatively short time placed orders abroad for steam yachts, which in the aggregate will amount to a very considerable sum. Why they deliberately passed over the talent of American naval architects, and the skill of American shipbuilders, not taking any account of a proper patriotism, is a question which no persons but themselves could intelligently answer. That good boats can be built abroad none but an ignoramus would deny. That as good and better boats are built on this side of the Atlantic has often been shown. Wherefore the choice of these yachtsmen? It is not alone the monetary loss of the yachts to the home yards that hurts, but the very serious dis-

play of want of confidence in American genius. What will the foreigner, who is in need of ships, think of their actions? They are men of influence, and as yachtsmen, are supposedly familiar with the capabilities of American builders. It is pleasant to contrast with this the discrimination shown by Mr. Harrison B. Moore, the launch of whose yacht, *Marietta*, is recorded in this issue. Twice before has a yacht of the same name been built for him in an American yard. May he live to build and enjoy as many more. The new yacht is as fine a boat as any that ever made the trip between the Cloch and Cumbrae lights. Success to *Marietta*, the third.

In a recent editorial the New York Sun cited the number of mishaps to vessels of the British Navy, in one week, to show that "accidents are not peculiar to American ships." A comparison would not be entirely fair, taking into consideration the respective sizes of the navies. So far, however, as the engineering departments of our warships are concerned the officers would not fear a comparison made on strictly equal terms. Having in mind the shorthandedness of the engine-room staffs on the vessels of the American Navy, the only peculiarity is that accidents are not much more frequent. An investigation of the records of other navies would show that accidents are not rare in any. The liability to breakdown or mishap is inherent in all mechanical contrivances. When an accident happens the dryland sailor usually exaggerates its importance. It is the unfamiliar danger which is the more fearful. This citizen who, on a railroad train, hears with indifference that a hot box compels a wait, or that the locomotive has failed, gets nervous and apprehensive on an ocean steamship, even if the engines are only stopped. If he owns a bicycle which, when he is riding, develops about one-eighth of a horse-power, he can from his experience with repair bills appreciate how much greater is the probability of accident in apparatus which develops, perhaps, 10,000 horse-power, even allowing for the larger factor of safety in the latter.

Elsewhere in this issue will be found an account of a quick repair which was effected by the engine-room staff of the *S. S. La Grand Duchesse*. It is true the weather was good at the time and the element of risk did not enter into the matter at all. Nevertheless, it afforded a good opportunity for sizing up the inventiveness of the staff and the

ability to put ideas into prompt execution. American ingenuity can always be relied upon in an emergency. In receiving proper credit for his ability in emergencies, the engineer is at a disadvantage as compared with his brethren of the navigating department. The one is buried in the obscure depths of the engine-room, while the other is on deck, conspicuously in evidence in times of sudden peril or distress. There is, perhaps, only one time during the life of a steamship when the engineer receives his dues—that is the trial trip. Attention is then attracted to the management of the engine-room, especially when the builder receives a handsome bonus for speed. The substitution, however, of bare poles, in the modern steamship, for the heavy rig of former days, must direct the attention of the thoughtful to the reliance which has come to be placed on those down below. There is as much necessity for courage and knowledge on the starting platform as there is on the flying bridge. A competent engine-room staff is an added insurance of safety, which the passenger may well consider, and for which the shipper has no extra rate of premium to pay.

Secretary John D. Long, of the Navy Department, has taken a very proper stand in refusing to permit any unfairness toward the employes in the Navy Yards, for the benefit of political mechanics, who expected to get easy jobs under the new administration. It needed the exercise of good judgment and courage to give this reply to the influential congressional delegations, from the districts in which the various yards are situated. There was no halfheartedness either about the answer of the Secretary of the Navy, which reads:

"It is the intention of the Department to enforce fairly and justly the regulations as promulgated; and to disarm unjust criticism it is necessary that the attention of each officer at the yards be called to do what is expected of him, to the certainty of punishment if any person intrusted with the enforcement of the labor regulations violates them, or fails, through carelessness and negligence, to perform the duties expected and required of him."

The "machine" experts will consequently not have the privilege of doing scamped work at the taxpayers' expense. If there is any work in which the moral obligation to be thorough is more binding than another, that work is the construction of ships of war. The very honor of the nation may depend upon the skill and care with which some minor part of the mechanism of a war vessel is constructed. Merit alone should rule in the selection of employes.

THE ENGINEER, BY AN ENGINEER.

At the recent anniversary dinner of the Stevens Institute of Hoboken, N. J., Engineer-in-Chief George W. Melville, U. S. N., responding to a toast, made several statements which, though they refer primarily to the Naval Service, can with much profit be considered by members of the Merchant Marine. For the benefit of such the following extracts are here published:

* * *

It has been a crime of the engineering profession that it has been too indifferent in securing due credit and honor for its professional achievements. The technical expert and scientist has been too backward in claiming the substantial rewards of his labor, and this lack of business efficiency has always stood in the way of his official, financial and social advancement. The legal and medical fraternity have each established a code of ethics which secures to its members and to the profession the reward of individual labor. But the engineer has too long been content to build the foundation, and even the structure of great inventions, and then permit others to claim the rewards which should accompany his work.

* * *

The triumph of the engineer over prejudice and tradition has been comparatively rapid, for it required but fifty years to make steam the principal motive power on board warships. Official recognition has not yet been given to the work of the engineer, and particularly in naval matters has the engineer been unjustly treated. The attempt to deprive him of a just share of the rewards and emoluments of the naval service has impaired the efficiency of the organization, and has caused bitter internal strife, which is to-day our great naval weakness, and whose continuance invites disaster in time of battle.

* * *

There came with the naval engineer the civilizing influences of the song of steam, and with each successive advance in the installation of a higher type of engine and steam generator, there has been a progressive improvement in the character and intelligence of the crew. And, therefore, with much joy not only the engineer but the world can say: Gone are the days when the captain of a warship was an absolute despot, and when naval crews were composed of desperate men, who, in the opinion of the sailor officers, could only be made amenable to discipline by being flogged into shape.

* * *

Our naval commanders of the past century bequeathed to this nation predominance on the ocean, a predominance which was lost in the transition from the sail to the steam age. This inheritance will yet be reclaimed, but it will be secured as much by the work of the engineer as by that of the sailor. And if the national government will permit the scientific colleges to send forth the elect of their graduates to compete for commissions in the naval service, then it may be that the genius of the engineer graduates of such institutions as yours, will bring about the restoration of that command of the sea which our people have too long been dispossessed of.

CORRESPONDENCE.

[We do not assume responsibility for the opinions expressed by correspondents.]

Deposit in Cylinders Causes Trouble.

The engineers of our line have had a good deal of trouble with cylinder oils. We use a very good brand, and while the engine is running there is no apparent difficulty. At the end of a voyage, however, it is a common experience on removing the covers to find the rings stuck fast in the pistons and valves by a deposit, a lump of which I send you with this. When the deposit is soft it is easy enough to remove, but if the cylinder has not been opened for some time it is troublesome to clean. The stuff gets as hard as a piece of iron. We sometimes get great quantities of it from one engine. The tops of the pistons will have big patches of the stuff, thick enough to fill up the clearance, and it will be flattened by contact with the inside of the cover. The rings are stuck so tight often that they have no elasticity at all. It not only bothers us in this way, but we have to open up the engine just for the purpose of removing this stuff. There is a difference of opinion as to what the stuff is composed of. Some of the engineers think it is formed by organic matter in the oil, which is carbonized by the heat of the steam, but others believe it is a sort of clay which is put in the oil to give it body. I would like to know if our experience is peculiar, or if any other engineers have had the same bother and if they know what the deposit really is.

TRANSATLANTIC.

[The substance accompanying this letter was of the consistency of putty and dark in color. We have submitted it for analysis.—Ed.]

Wants Pointers About Water-tube Boilers.

Will some of your readers who have had practical experience in the management of water-tube boilers give me a few pointers. I am an engineer employed by a company whose older vessels are fitted with Scotch boilers. In one of the newer boats water-tube boilers have been put in, and I expect soon to be transferred to her. I have read a good deal about the water-tube boiler, including the discussions between the advocates of the shell boiler and the newer steam generator. What I am after is not theoretical suppositions, but facts concerning the everyday use of the boilers. How to work them, and not whether they are the best adapted to the service, is what I want to know. I have been told that these boilers require a good deal of care and watching, that the firing has to be done differently from the old method, and that the feed needs close attention. Can dependence be placed on automatic apparatus for this purpose? Many others, I am sure, would appreciate a few pointers, for considering how many of the new ships have water-tube boilers, any engineer is liable to have to handle them.

WATER-TUBE.

Oil in Feed Water.

I should like to obtain information from your seagoing correspondents as to how they can use, continuously, the water from their surface condensers without injury to the boilers, from oil. Several large

stationary plants have been installed with surface condensers, with a view of saving the city water bills, but I have known of several instances where the oil, fed to the boilers with the returning water, has caused burnt tubes in water tube boilers or bags in shells, and they are now throwing the condensed steam from the condenser away and buying a continuous supply of water from the city mains. It is certain that the water is used over and over on shipboard. How do they manage it? RALPH.

Failure of Condenser Tubes.

There is nothing it seems to me, in the economy of the engine room, so little understood as the subject of condenser tubes. While there has been steady progress in boiler construction, steam expansion, and auxiliary apparatus, there is retrogression, even more rapid, in the condenser. This is assuming that other companies have the same experiences as ours, and as far as I know they have. In my own experience condenser tubes have always given trouble, but have especially since the use of steam pressures of 100 pounds and upwards. Now as to the details. There is no uniformity in the wearing qualities of tubes even under the same conditions. Some will not stand one voyage across the Atlantic, while others, of the same make and material, will last six months and even years. The corrosion and failure of the tubes is invariably on the sea water side. Thus it cannot be charged up to the oil which may pass over with the exhaust steam. The point where the tubes suffer most is at the ends where the salt water enters the condenser. I have tried tubes of various alloys, tinned and otherwise, and from as many different makers, and yet the general result is the same in all cases. There does not seem to be any change in the rate of decay, whether the condenser shell is made of brass or iron. The use of zinc plates in the water chamber does not prevent corrosion, though probably it may prolong the lives of the tubes. The destructive action on the plates is indeed very marked. In condensers of large capacity I have frequently found a zinc plate 9 in. by 6 in. by $\frac{5}{8}$ in. completely oxidized within two weeks, and when removed so brittle that it would crumble to pieces in the hands. What connection there is between high pressure steam and this remarkable shortening of the life of a tube I cannot understand, unless it be that manufacturers nowadays do not make as good a tube as in the early times of low pressures. I would like to hear from others as to their experiences and have the benefit of their ideas.

A. C. B.

Here is a Poser.

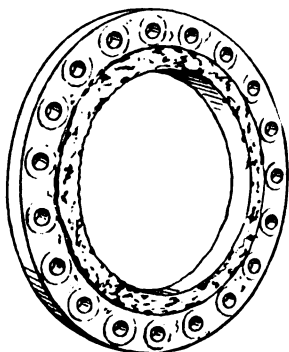
In case a vessel develops leaks in her condenser which are not serious enough to necessitate stopping the engine and opening the condenser, to plug tubes, etc., the feed water will have a quantity of salt water added to it. Suppose this quantity leaking in, in a given time, to be, say 5 per cent. of the amount of water fed to the boilers in that time. The two methods to dispose of this excess of feed water are: 1st. Put the whole quantity in the boilers and blow down occasionally, thereby reducing the density each time—but the density is gradually rising. 2nd. Allow the excess to escape from the hotwell, thereby causing the density in the boilers to rise gradually also. In both cases the supposition is that the density does not go dangerously high before the end of the voyage. I would like to hear from seagoing engineers, which of these two methods, in their opinion, is preferable, and which will deposit the most salt in the boilers.

EL.

MISHAPS AND REPAIRS.

Steam Supply Improvised.

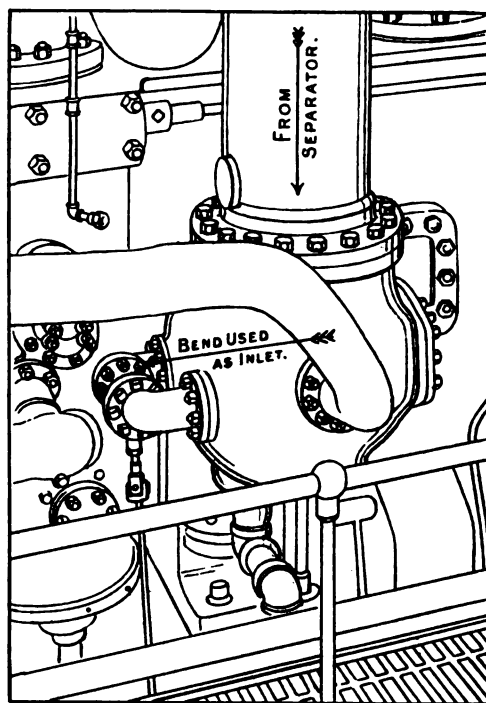
An occurrence in the engine room of the Plant liner *La Grande Duchesse* on a recent trip is of special interest as showing the promptness and skill with which a readjustment of conditions was effected. This splendid vessel had left Savannah in the afternoon, and was speeding northward to New York at about 17 knots an hour at the time. The boilers were giving steam at 225 pounds freely and the engines working smoothly, without the least indication of anything wrong. About 10.30 o'clock at night, the engineer on watch was on the starting platform when a sharp report overhead, accompanied by a rush of steam at the tremendous working pressure and the slowing down of the port engine, indicated that something had given out. He immediately closed the throttle of the engine and investigated. From the neighbor-



BROKEN FLANGE.

hood of the separator, which was fitted in the main steam pipe just inside the forward engine room bulkhead, close to the bend leading down to the H. P. valve casing, steam was rushing upwards in great volumes. As the skylights were open, the engine room did not fill up with vapor, and as none of the staff was on the upper platform there were no casualties to consider. Chief Engineer Thomas Devlin was in his cabin when the explosion occurred. He was in the engine room an instant later, and told off a gang of men to close the main stop valve at the boilers. He also gave orders to ease the fires, and turned out the entire engine room staff for emergency duty. When the steam was off the engine, the asbestos covering was quickly torn away and the real damage ascertained. The outlet neck of the cast iron separator had split all around, except for a distance of about 8 in. at the bottom. At the top the (2) portions of the pipe had pulled apart $\frac{1}{4}$ in. The steam main is 14 in. dia. An inspection of the accompanying illustration will show just where the break occurred, close to the after flange of the separator. The fracture was regular, its circumference being almost equal-distant from the flange face at every point. The thickness of metal was $1\frac{1}{4}$ in. of good grain, and apparently free from blow holes or defects. The separator itself was 28 in. long, having flanges with male and female faces 1 in. wide, fitting corresponding ends in the cast steel steam mains. The flanges were 24 in. dia., held together with 19, 1 in. bolts with a single thickness of packing surrounding the surface ends. Chief Engineer Devlin immediately decided to leave the break as it was and, if possible, make a steam connection with the engine so that the boat would not have to proceed with one propeller only. He selected the bypass on the throttle valve as the point for the new connection. The bypass is made up of three sections, as shown in the cut, two of which were removed, leaving only the bend next to the cylinder. This gave

a 2 in. inlet to the H. P. valve chest below the throttle valve. The supply was got by disconnecting the drain pipe from the bottom of the starboard engine separator, which was also 2 in. dia. A search was made for connecting pipe, as there was none available in store, and a length of brass pipe was taken from the fresh water filling pipes. With spare elbows, the connection was quickly fitted. The connecting pipe was stretched between the engines, passing under the upper platform of the port engine, a distance of about 14 ft. Steam was then turned on both engines, all the boilers being kept going, with fires eased, so that steam would be plentiful and no possibility of trouble from priming. The port engine gave 84 revolutions, the starboard engine making the regular 120 revolutions. It was just three hours after the explosion when both engines were going again. In this condition the liner went ahead at a speed of 14 knots, and steered very handily. With one engine only the speed would have fallen to $11\frac{1}{2}$ knots, and steering would have been difficult. As most of the passengers were asleep when the break



THROTTLE VALVE PORT ENGINE.

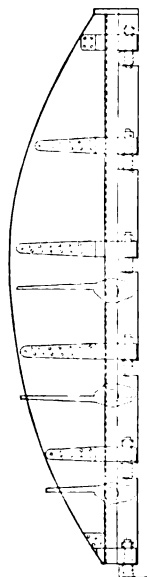
occurred, and the repairs were so speedily executed, no one probably knew that anything had happened, nor was any trouble apparent when the liner entered this port and docked. The delay in arrival did not exceed 5 hours.

Replacing a Rudder and Rudder Post.

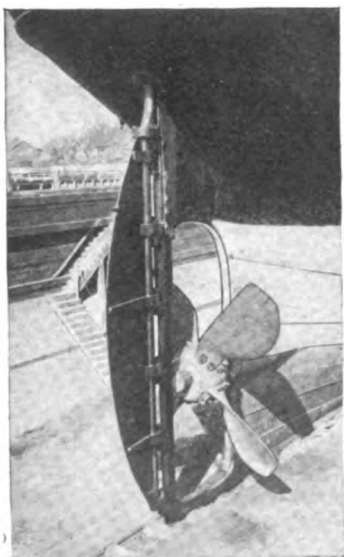
The *S. S. Borderer* while on a passage to Boston in February was unfortunate enough to lose her rudder and rudder post, during a heavy gale. Attempts to rig a jury rudder were unsatisfactory, so when a fishing schooner was spoken, a bargain was made with her captain to tow astern of the *Borderer* and act as a rudder for the steamer. This scheme worked well, and in due time, they reached Boston Harbor. After unloading, the steamer went into dry dock at East Boston, and a survey was made. It was then found that the rudder post had broken square off at the 20 ft. mark on the post and close to the stern post at the bottom. The rudder was broken off about 8 ft

down from the head. It was decided to make temporary repairs to the rudder post and fit a new permanent rudder.

The design of the rudder is shown in the outline drawing. It consisted of a round iron rudder stock 28 ft. long, with a flange coupling on the top end. The size of the stock varied from 9½ in. dia. at the top end to 7 in. at the bottom. On to this stock was shrunk and keyed six wrought iron braces, with the alternate brace arms on the opposite sides of the rudder plate. The rudder plate was 1½ in. steel, 28 ft. long by 4 ft. 10 in. wide, notched over the brace hubs and fitting into a keyway 1½ in. deep, the whole length of the rudder stock. The pintle pins 4¾ in. dia. were forced into the braces with a taper fit, and secured by a 4 in. nut. After being riveted, all joints about the plate were carefully caulked. This rudder complete weighed seven tons. In making the repairs to the rudder post, the ends were squared, butted, and fastened by cover pieces 2½ in. thick by 5 ft. long. These covering slabs were fastened with driven 1¼ in. turned rivets in reamed holes. At the bottom end it was necessary to use filling pieces 1¼ in. thick under the slabs to make the work flush with the garboard doubling plate. There was used at the bottom end in addition to the 1¼ in. rivets three 1¼ in. dia. turned rivets driven through slabs, filling pieces and the solid stub of the keel.



RUDDER DESIGN.



REPAIRS COMPLETED.

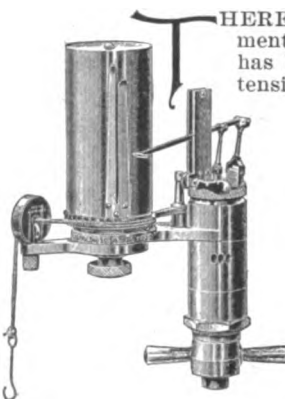
The rudder post had four lugs for pintle pins, and was planed, drilled, and bored for pintle pins, by templet in the shop so that when put in place it fitted perfectly with everything in line. Not a file or chisel was used on any part after leaving the shop. The post was 20 ft. long, vertically, extended 8 ft. forward to the stub of keel, and weighed five tons.

Bids for the work were asked for and the contract was awarded to The Lockwood Manufacturing Company, of East Boston, to be finished in fifteen working days. The work was done in the most satisfactory manner in the short space of twelve working days. Forgings for the job were furnished by the Boston Forge Co., of East Boston.

EDUCATIONAL.

THE INDICATOR APPLIED TO THE MARINE ENGINE.—1.

BY HENRY L. EBSEN.



HERE is probably no instrument used by engineers which has been written about as extensively as the indicator, and yet so important is the subject of its application and uses, that he would be a confident engineer who would say he possessed an entire knowledge of it, in all phases and aspects. There is to be had in the application of the indicator to marine engines a variety of results, greater and more significant than any which can be obtained from its application to

land engines. It will be the purpose of this article to note some of the results, as well as to give information about the correct manipulation of the indicator, for the guidance of those who have not made the subject a special study.

Let us first consider the instrument as a means of measuring power. Ordinarily it is desirable to know the power developed in a steamship to be able to make comparisons with the water and coal consumption. In vessels that are in regular service it is almost an impossibility to give accurate figures of these comparisons, for the reason that a part of the coal burned goes toward driving the auxiliary plant, consisting of electric, ventilating, refrigerating, steering, pumping, evaporating, heating and cooking outfits. The exhaust of some of these auxiliaries is led to the receiver of the low pressure cylinder of the main engine, of others to the feed heater, and yet others to the main condenser or hotwell. As the power of the auxiliaries is a very variable quantity matters could not so be arranged, that, say, one boiler would take care of the auxiliaries and the other boilers be connected with the main engine and feed and circulating pumps, or, in other words, to separate the auxiliary plant from the propelling plant. Therefore, it is customary to quote the efficiency of the entire plant by comparing the total coal consumption with the horsepower of the main engine. As the auxiliary system of the large fast passenger ships contains a great number of engines which are not economical in the use of steam, and the loss of heat due to condensation in the net work of the pipes is considerable, the figure of the efficiency of the entire plant is often a disappointment if the above facts are not properly appreciated. Furthermore, it does not allow of close comparison between different types of vessels, as for instance between a freighter, with only a few auxiliaries, and a fast passenger vessel; even if both have the same style of modern economical main engines.

Another use of the indicator is to enable the engineer to regulate the distribution of power in the different cylinders of the main engine. All main engines have a linking-up device on the valve gear of each cylinder, independent of the reversing gear. In order to give a uniform rotative effort to the shaft, it is necessary that the total power of the engine be divided evenly on the different cranks. Take for instance a triple expansion engine, properly designed, running with links full out and the power evenly distributed. If it should become necessary, on account of cleaning fires, or poor coal, to reduce the

quantity of steam to the engine in order to keep up the boiler pressure, the high pressure cylinder would be linked up first, decreasing its cut off, reducing the total amount of steam passing through the engines, and correspondingly reduce the total horsepower. Under these changed conditions, the high pressure cylinder would have a greater power than either the intermediate or low pressure. It thus becomes necessary that these be linked up likewise until the powers are again even. If the low pressure cylinder drives the pumps, it is allowed a corresponding excess of power. In cases where the crosshead, crankpin, or other working parts of one cylinder are at any time giving trouble, it is a very simple matter to reduce the strain on them by reducing the power of the cylinder, giving part of it to the next, or distributing it among the other cylinders, and at the same time not materially reducing the total power. But the valves of the last cylinders usually have a longer travel than those of the first cylinders, so the linking-up process cannot be adjusted proportionately offhand, but must be studied with the help of the indicator. This becomes very apparent in quadruple expansion engines.

Again, in twin screw vessels, it is essential that the powers of the two engines be equal, so that each will give the same amount of thrust. If one engine develops more power than the other, when sailing a straight course, the rudder must be put over several degrees, and this drag impedes the speed. The two engines, one right handed and the other left handed, will occasionally show a difference of power, sometimes even when running at the same number of revolutions, and to bring them even by linking-up slightly on the one developing the most power, the indicator is indispensable.

Motor Boats at the Sportsmen's Exposition.

At the recent Sportsmen's Exposition at Madison Square Garden there was an unusually interesting series of exhibits of motor boats. In most of these the propelling power was obtained by the use of naphtha or other similar liquid.

The Gas Engine and Power Company, Morris Heights, N. Y., exhibited an open launch, 25 ft. long, fitted with a four H. P. engine, built for use on Lake Minnetonka. The frame was oak with cedar planking and the upper works were finished in oak and mahogany, highly polished, which, with the brass railing, gave the boat a very elegant appearance. An 18 ft. cedar, clinker built, yacht tender, built for Major C. F. Ulrich, was also shown. This was a very serviceable looking boat. On a draught of 20 in. it was designed to make nearly 7 miles an hour. A triple expansion steam engine, built in the company's shops, called out much favorable comment from those interested. It had cylinders 7 in., 11½ in. and 17½ in. by 10 in. stroke. At 160 pounds' pressure and 140 revolutions, the engine indicated 150 H. P. One noticeable feature of the design was the small amount of cast iron used. The frames even were steel columns, stoutly braced, giving a very rigid and easily examined engine.

A vapor engine of the Marine Vapor Engine Company, Jersey City, N. J., was shown in operation at its stand, a portion of the valve casing being cut away so that the motion of the parts could be easily followed. Alcohol is used as the motive power in this engine. The alcohol is vaporized in a retort, which is heated by a kerosene flame, and the vapor is used expansively in the cylinder. Owing to the absence of shock from the explosion of inflammable gases, which are utilized in other motors, a great steadiness is claimed in running. The vapor after passing through the cylinder is condensed and returned to the alcohol tank. At this stand several motor boats were

displayed. The largest, a 25 ft. cabin boat, built of oak and cedar with mahogany finish. It was fitted with a 5 H. P. engine and guaranteed to go 9 miles an hour. A large tank for kerosene was fitted forward, and the interior cabin arrangements were arranged for extended cruises.

A 50 horse-power Globe gas engine was shown at the stand of the Pennsylvania Iron Works Company, Philadelphia, Pa. This, considering the power developed, occupies a very small floor space; vastly less than a steam engine and boiler could be got into. A 6 H. P. motor with shaft and propeller attached was also exhibited, in motion. An 18 ft. cedar boat, built by the O. Sheldon Company, of Boston, who supply the hulls in which Globe engines are fitted, was a good example of a handy, durable craft.

A very fine cruising boat with cabin was in view at the stand of the Daimler Motor Company, Steinway, Long Island. The dimensions of this boat were: Length, 33 ft.; beam, 8 ft., and draught of water, 8½ ft. It was fitted with a 7 H. P. motor of the Daimler type, sufficiently powerful to give the boat a speed of 9 miles an hour. The storage tank was of 150 gal. capacity. The boat was beautifully finished in oak and mahogany. The cabin was richly upholstered. In the forward end a binnacle and wheel were fitted while aft of the cabin proper there was a most convenient pantry and storeroom. The engine took up a very small space in the stern, leaving ample seating room under the awning.

The exhibit of the New York Launch and Engine Company, Morris Heights, N. Y., included a 21 ft. naphtha launch, in which was fitted a 40 gal. fuel tank, so that long cruises could be conveniently made. The Otto Gas Engine Company exhibited at this stand a 25 H. P. engine of its well-known marine pattern, a very compact and strongly built machine.

A portable boat motor, which can be attached to any row or sail boat up to 18 ft. in length was shown at the stand of the American Motor Company, Havemeyer Building, New York. This is fitted with a reversible propeller, the propeller also being used as a rudder. The weight of the apparatus is 70 pounds and a speed of 6 to 8 miles per hour is guaranteed.

The Manhattan Manufacturing Company, 120 Liberty street, New York, exhibited one of its small marine type engines, with shaft and reversible propeller connected. This engine is enclosed in a metal case of small dimensions, the working parts running in oil, and as it is fitted with ball-bearing thrust bearings, a great reduction in friction is said to result.

The exposition was well attended throughout and the launch builders' stands were among those most frequented by visitors.

The total of domestic exports from the United States for the month of January, 1897, was \$92,472,312, as against \$85,543,304 for the same month in 1896. Of agricultural products the exports were to the value of \$66,694,508, and of manufactured products, \$20,622,850. The greatest gains occurred in the exports to Great Britain, Germany, Belgium and China. Exports to South American countries show a decline in the same time of about \$500,000. Of the exports for the month, goods valued at only \$6,193,914 were carried in American ships, while \$82,061,257 worth went in foreign vessels. Of imports \$7,398,823 worth came in American vessels and \$41,617,167 in foreign ships.

The Clyde Line steamship Saginaw went ashore at Long Beach on March 24. There was a heavy rain and mist at the time. She carried mixed cargo and only one passenger, who was brought ashore by the life-saving crew. Several mishaps to sailing craft occurred the same day.

HOME AND FOREIGN EXCHANGES.

Traffic in New York Harbor.

Reviewing the traffic conditions in New York harbor during the year 1896, Seaboard, in a recent issue, published a valuable article, with handsome illustrations, from which the following extracts are taken:

During the year 1896, 99,223 cabin passengers and 252,350 steerage passengers landed in New York, all coming from foreign countries. They were brought in on 822 trips made by vessels of 21 lines, and 30 trips by miscellaneous steamers. The North German Lloyd Steamship Company brought 38,034 steerage passengers from Bremen and 16,146 from Mediterranean ports; the Hamburg-American Line brought 32,280 steerage passengers from Hamburg, and 3,581 from Mediterranean ports; the White Star Line landed 21,220 steerage passengers; the Cunard, 20,000; the Anchor Line, 18,839 from the Mediterranean ports, and 6,448 from Glasgow; the French line, 17,371 and the American Line, 12,830. Of cabin passengers the American Line brought 16,859; Cunard, 17,909; Hamburg-American, 12,173 from Hamburg and 438 from Mediterranean ports; North German Lloyd, 10,921 from Bremen and 2,634 from Mediterranean ports, and the White Star Line, 11,607.

The ocean steamship lines which enter the port of New York are among the largest and most important on the globe. The finest ships the world has ever produced are to be seen leaving and entering the harbor every day. Such great ocean steamers as the *Campania* and *Lucania*, of the world renowned Cunard Line; the *St. Louis* and *St. Paul*, Paris and New York, of the American Line; the *City of Rome*, of the Anchor Line; the *Pennsylvania*, *Furst Bismarck*, *Augusta Victoria*, *Normannia* and *Columbia*, of the Hamburg-American Line; *La Touraine*, *La Bourgogne* and *La Normandie*, of the French Line; the *Spree* and *Havel*, of the North German Lloyd; the *Friesland*, *Westernland*, *Noordland* and *Kensington*, of the Red Star Line, all magnificent passenger ships, with their many consorts, are to be seen almost constantly passing through the harbor, either starting on their voyage or reaching the port after a trip from the other side of the world. These boats are used chiefly to carry passengers, while the bulk of the freighting business is carried on in steamers especially fitted for this work. The biggest cargo-carrying vessels that ever floated are to be seen in the port at all times, among which the great White Star freighters, those of the German lines, and the hosts of "tramps" or roving steamers, moving about the harbor, combine, with the local traffic, to make it life and animation, and present to the eye a constant succession of marine pictures.

Of course the leading transatlantic steamships surpass all others running from the port, in point of size, but there are a large number of splendid vessels, and these constructed in American shipyards, which ply to various ports along the coasts and to the West Indies, to Mexico, Central and South America, and for comfort they are oftentimes in advance of the more pretentious "Royal Mail" steamers. Take, for example, the *La Grande Duchesse*, owned by the Plant System. Here is a vessel which in some ways is unequalled by any in the world. While not as big as the foremost steamships running across the Atlantic Ocean, yet she is a stronger craft, has more modern improvements, and is, taken all in all, a superior boat to many of them. The new *Creole*, 3,800 tons, of the Cromwell Line, running to New Orleans, is another fine specimen of the shipbuilders' art. The *John Englis*, a coasting steamer which lately went into commission, is probably the best boat of her class in the world, while the numerous fine steamers of

the Old Dominion, Savannah, Clyde, Mallory, Morgan, Ward, Red D, and other lines, are as perfect and finely equipped as they are typically American.

Leaving the port of New York every evening summer and winter, bound for various points within 200 miles, is a fleet of inland steamboats which cannot be matched in any other part of the world. These great vessels, daily freighted with a thousand or more passengers, and a large cargo, steam away at the rate of twenty miles an hour, reaching their destination in the early hours of the morning, and running with the regularity of a railroad train. Such vessels as the *Priscilla*, *Puritan*, *Plymouth*, *Pilgrim*, *Adirondack*, *Drew*, *Dean Richmond*, *City of Lowell*, *City of Worcester*, *Connecticut*, *Richard Peck*, etc., could only be duplicated by the expenditure of from \$800,000 to \$1,500,000.

In the harbor of New York there are nearly fifty ferry lines, 150 steamers being actively engaged every day in transporting passengers and vehicles to different points along the shores. No freight is carried by these boats, except what may happen to be loaded on to trucks, etc. For the purpose of transporting heavy freight, etc., from one point to another, hundreds of steam lighters, canal boats, barges, etc., are constantly engaged. The vessels which have no steam of their own are towed about the harbor by the 500 tugboats which are owned by the various transportation companies and others. In Brooklyn, on the East River, is located the United States Navy yard, the most important in the country. Here naval vessels are built and repaired, and employment given to 2,000 men at all times. The dry dock is one of the best in the country, and cost \$2,000,000.

During 1896 a total of 4,460 vessels arrived at New York from foreign ports. They were divided up as follows: Steamers, 2,948; ships, 176; barks, 345; brigs, 99; schooners, 802. From all coastwise ports there were 10,229 arrivals in the harbor. These consisted of 1,787 steamers; 13 ships; 52 barks; 24 brigs and 8,353 schooners. New York exported 18,476,263 bushels of wheat, 19,100,190 bushels of corn, 15,880,150 bushels of oats during the year 1896. The coal mining industry of the port amounts to \$82,000,000, the steamship lines using 1,425,000 tons annually. The amount of freight transferred at the port of New York annually is estimated at 80,000,000 tons. For the six months ending January 1 the receipts for customs at the port of New York were \$45,425,927.64, while the January, 1897, receipts were \$7,705,400.36. The total exports for the seven months ending January 31, 1897, were \$268,275,831, the imports for the same time being \$304,247,879.

A New Mail Steamship Record.

The following paragraph from the *Yachtsman* is of particular interest, not only as recording a phenomenal service speed for a passenger steamer, but because it is over this route that the American mail, which crosses the Atlantic via Queenstown, is carried.

Much interest centered at Kingstown, last week, in the first trial trip of the first of the four new Irish Channel mail screw-steamers. The new vessels are named after the four Irish provinces, as in the case of the old paddle-steamers which have been on the station for over 36 years. The first vessel finished is the *Ulster*. The day was, in most respects, an ideal one for a trial, water just smooth, with the faintest roll off the Race. At Holyhead breakwater *Ulster* gave Ireland, the crack of the old paddle fleet, a short start, but soon overhauled and passed her. When "full speed ahead" was rung down to the engine room, it soon became very evident that the passage would be "a record." The *Kish* lightship was left to starboard in 2h. 4m. 30s., and the *Burford* buoys

8m. 30s. later. Then she began to slow down for Kingstown harbor, and the piers were entered at 4 p. m. The across-channel passage, from breakwater to breakwater, was accomplished in 2h. 26m., the mean speed being 23.4 knots per hour. Ulster, therefore, holds the record as the fastest mail-steamer afloat. She is a distinct departure from the old across-channel type of paddle-steamers, and, indeed, is not unlike a diminutive Atlantic liner, with an uninterrupted promenade deck along each side from her foremast aft, and a small hurricane deck over the forecastle. She promises to be a good sea-boat, and there are hopes of her making a still better record when her officers get to know her ways. The three other vessels, Munster, Leinster, and Connaught, are to be on the station by April 1. All three have been built by Messrs. Laird, of Birkenhead, who were also the constructors of their old paddle-wheel namesakes.

Floating Pneumatic Grain Elevator.

A floating pneumatic grain elevator has been put in service, recently, at the port of Limerick, Ireland, which possesses many interesting features. This vessel, the Garryowen, as described by *The Engineer* (London), is 170 ft. long and 16 ft. 6 in. deep, with propelling engines of 240 horse power and a speed of nine knots.

The machinery mainly consists of two high-pressure steel boilers, constructed to the requirements of the Board of Trade, each 10 ft. 6 in. dia. by 11 ft. long, and having two furnaces 3 ft. 2 in. dia., fitted with Adamson rings and provided with separate combustion chambers. The working pressure is 120 lb. per square inch. The pneumatic engine is of the horizontal type, and its bed-plate is formed by steel girders 56 ft. long, forming part of the frame of the vessel, and greatly adding to its strength. The engine is of the ordinary compound type, having a high-pressure cylinder 22 in. dia., and fitted with an expansion valve and a center-weight high-speed governor. The low-pressure cylinder is 42 in. dia., and there are two pneumatic cylinders to each side of the engine of 38 in. dia., and having their pistons fitted on to prolongations of the piston-rods of the steam pistons. The stroke is 48 in., and at forty-two revolutions 440 indicated horse power is given out.

The work required from the pneumatic engine may be divided into two distinct parts, a suction action through one set of pipes to lift the grain out of the ship and deposit it in the receiving tanks, and on the return stroke of the piston to compress the air and force the grain out of the lower set of delivery tanks, and then convey it through the shore mains and deliver it into any required compartment in the warehouses. In the former case the air is drawn off from the upper part of the receiving tanks, and the grain falls by gravity into the discharging boxes, and thence into hoppers. Below these hoppers are placed one-ton automatic self-registering weighing machines. The discharging boxes consist of two compartments having ports on the top, alternately opening to the receiving tank, and rocking to and fro on a shaft, so that one side is being filled with grain while the opposite compartment is being emptied. Inclined shoots are provided between the weighing machines and the pressure tanks, and doors are also provided to regulate the speed of the delivery to the pressure tanks to suit the inflow of grain into the receiving tanks. When once adjusted to suit any kind of grain, wheat, maize, etc., which may be required to be operated upon, the whole of this portion of the plant works automatically and without attention.

Auxiliary air chambers are placed on deck to serve as dust collectors between the suction-receiving tanks and the pneumatic engine. These chambers are of large capacity, and are provided with internal pipes

and cones, so that any dust which may be held in suspension by the air after leaving the first receiver is projected by its velocity beyond the cones on entering the enlarged space, and cannot again mix with the air, and the dust so collected can, by an arrangement of air locks, be returned to the grain, so that the cargo shall not suffer any loss of weight, but the quantity of such dust to be dealt with is comparatively small.

The usual engine-room staff, together with a captain, mate, and four deckhands, who also couple up the pipes, are required to work the elevator, and a man, or intelligent lad, is required to attend to each pipe in the holds of the ship, to lower and move them about as may be required. The cost of working, including coal, etc., may be approximately taken at 3d per ton with bulk cargoes, but may be somewhat less or more, according to the circumstances of each case.

American Coal Ousting British.

The constantly increasing export of American coal has aroused the British miners and shippers to a little alarm for their markets. The following shows the distribution of the exports of United States coal during the three years stated:

Exported to.	1893. Tons.	1894. Tons.	1895. Tons.
Bermuda.....	3,157	2,823	5,047
Canada:			
Nova Scotia, etc.....	89,586	97,869	104,680
Quebec, Ontario, etc....	1,907,723	2,704,562	2,941,542
British Columbia.....	3,074	502	1,977
Newfoundland.....	3,203	2,366	5,551
West Indies:			
British.....	14,399	23,443	22,593
Danish.....	37,006	41,461	30,420
Dutch.....	1,713	1,673	2,247
French.....	33,017	38,861	43,203
Hayti.....	525	1,031	1,108
San Domingo.....	2,468	3,773	4,337
Cuba.....	333,914	331,902	418,700
Porto Rico.....	18,309	15,301	30,266
Other Countries.....	398,773	349,624	250,120
Total.....	2,846,667	3,615,191	3,870,701

Here we see, says London *Fairplay*, the exports increased by upward of one-third within three years, and notwithstanding serious interruptions at the mines. Beyond doubt the competition of the United States with British coal in the not very dim and distant future in markets which it has not yet reached must be prepared for. Sellers of best Cardiff are foolish to turn up their noses at the possibilities of Pocahontas.—*The Marine Journal*.

The annual report of the Commissioner of Patents, John S. Seymour, for the year ending Dec. 31, 1896, made to Congress, contains many interesting details. It shows that the total number of applications for patents, for inventions, was 42,077. The total number of patents issued to citizens of the United States was 21,285, and to citizens of foreign countries 2,027. New York heads the list of States with 3,882 patents, while Nevada stands at the bottom with nine. Connecticut leads in the proportion of patents issued to inhabitants, the total number of patents being 983, or one to every 759 persons in the State. Among the European countries England is first with 617 patents, Germany a close second with 543, and France coming next with 194. Canada came in the list with 244 patents granted. The total expenditures of the office were \$1,113,413.71. The receipts over expenditures were \$210,646.12, and the total balance to the credit of the office, in the United States Treasury, amounted to \$4,718,639.47. The income was greater than any previous year, except 1890.

CONSTRUCTION NOTES.

Moran Bros.' Company, of Seattle, Wash., have work well advanced on Torpedo boat No. 8. This is one of the 170 ft. boats, with a breadth of 17 ft. and of 182 tons gross. They are also building two steel stern-wheel steamers, of light draught, for service on the Yukon River, Alaska. There has just been completed at this yard the new revenue cutter, "Golden Gate," for San Francisco harbor. This measures 110 ft. long, 20 ft. 6 in. beam, and 12 ft. 0½ in. deep. The engines are of 525 I. H. P.

Bath Iron Works, Limited, Bath, Me., reports great activity in the yard. The gunboats, Newport and Vicksburg, are nearly finished, and both will soon be sent on the builders' trial trip. There are two lightships on the stocks. The frames are up and part of the plating in place. These vessels will be ready for launching in about six weeks. Work has also been begun on a lighthouse tender, and preparations are being made for the construction of the torpedo boats for the government. The outlook for the season is very bright.

The Wolff and Zwicker Iron Works, Portland, Ore., are building lightship No. 70, for the Government. She is of composite build; the main framing, the reverse frames, floors and keelsons are of steel. She will also have one bilge strake of steel, and will be steel plated from the water line up. Below the water line she will be planked with 4 in. Bergen fir, with 2 in. oak sheathing and will be copper plated. The dimensions are: Length, over all, 123 feet; breadth, moulded, 28 ft. 6 in., with a mean load draught of 13 ft. The gross tonnage is 589.5 tons. She will have lower, main and spar decks, and three transverse bulkheads, up to the main deck. She will be fitted with two light masts. Interior finish will be in Oregon white pine and yellow fir, and there will be accommodation for ten persons in five staterooms. The propelling machinery consists of one single condensing engine 20 by 22 in., which at 100 pounds pressure and 150 revolutions will give 350 horse power. The main boiler is of the tank type, 12 ft. diam. and 11½ ft. long. The usual auxiliaries are fitted. There is also a steam hoist, and special steam and fog signal apparatus, as well as an electric light plant.

F. W. Wheeler and Co., West Bay City, Mich., have nearly finished a 2,500 ton steamship, designed to carry wood pulp. The dimensions are: Length over all, 281 ft.; breadth, 42 ft.; depth, moulded, 19 ft. The hull is of steel; the bottom sheathed with oak to the upper turn of the bilge. There are four bulkheads, three of which are watertight, and one screen bulkhead fitted with two doors in the lower hold. There is only one deck, with topgallant and forecabin deck, and full poop. The deck is fitted with seven hatches, in each of which a pulp wood conveyor, built by the M. Garland Co., of Bay City, is fitted. Four of these discharge over the starboard rail, and three over the port. The vessel will have a speed of twelve miles an hour. The engines for the single screw are triple-expansion, with cylinders 17 in., 28 in., and 47 in. dia. by 36 in. stroke. They will develop 1,000 H. P. at 100 revolutions. Steam will be supplied at 175 lbs. pressure by two Scotch boilers, 11 ft. by 12 ft., each fitted with two Adamson ring furnaces with separate combustion chambers, working under natural draught. The deck appliances include a Williamson steam and hand steering gear, a windlass with capstan connected, by the American Windlass Company, and an independent steam capstan aft, of the same pattern.

The Cleveland Ship Building Co., Cleveland, O., is building steamer No. 27, for the Wilson Transit Co. She will be 400 ft. long between perpendiculars; 420 ft. long, over all; 48 ft. beam, and 28 ft. deep. The construction is on what is known as the channel bar sys-

tem, of the Carnegie Steel Company's open hearth steel plates and shapes throughout. She will have a water-bottom 5 ft. deep, capable of carrying about 2,000 tons of ballast. There will be twelve hatches in the spar deck; the usual style of barge cabins, made of wood throughout, with interior finish in quarter sawed oak. The rig will consist of three pole masts. Steam steering gear, steam windlass and capstan forward, steam capstan aft, two steam capstans amidships, and one of the builder's steam hoisting engines amidship will be fitted. The propelling machinery will consist of a triple-expansion engine with cylinders 23 in., 38 in. and 63 in. dia., and 40 in. stroke, turning a propeller 13 ft. dia. and 17 ft. pitch. There will be three Scotch boilers, each 12 ft. dia. and 13 ft. long, having a working pressure of 175 lbs. to the sq. in. It is estimated this power will easily drive the vessel twelve miles an hour, loaded. No. 27 is designed to carry 4,000 gross tons of ore on 14½ ft. mean draught, or about 6,000 gross tons on 16½ ft. It is the intention to have her ready for sea on the opening of navigation. The owners and builders expect to have one of the best ships that has ever been turned out on the lakes.

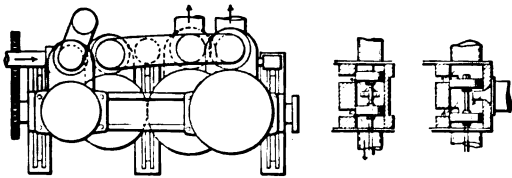
The Neafie and Levy Ship and Engine Co., Philadelphia, have under construction a steam pilot boat for the Pennsylvania and Delaware Pilots. This vessel is of open hearth steel, 148 ft. 8 in. long over all, 25 ft. beam, and 14 ft. 6 in. deep amidships. She has four watertight bulkheads, two ballast tanks, one galley tank, and one large tank for feed water. On the upper deck there is a forwardhouse fitted with seats, lockers and tables, as a deck cabin. There is also a raised pilot house of wood, and a large cabin aft for the captain, finished in hardwood. The crew's quarters forward are finished in pine, and arranged for twelve men. The after cabin will accommodate twenty men. It is finished in white pine, enameled and gilded, with mahogany trimmings. All the furniture is of very artistic design, and the plumbing and sanitary appliances fitted, are equal to those on any yacht. The propelling machinery consists of a compound engine with 20 in. and 40 in. cylinders by 28 in. stroke. The air, feed and bilge pumps are driven by the main engine. The shafting is extra heavy, 9 in. dia. at the thrust, which is of the builders' improved horse shoe type, adjustable by wedge blocks. The engine has been designed with a view to durability and economy, all bearings being large, and in view of the expected power, all pipes, valves, etc., have been made large and free. A large wrecking and fire pump is installed in the engine room recess with suction and fire deliveries on deck. The donkey feed pump and circulating pump are independent. Steam is supplied by a Scotch boiler 13 ft. dia. by 14 ft. long, with about 2,300 sq. ft. heating surface. It is built to pass U. S. inspection for 125 lbs. steam. There is also an evaporator and distiller in the engine room, and a donkey pump in the fire room. A complete electric installation is fitted, with 10,000 c. p. search light, a signal lamp, and incandescent lamps in the various quarters. The dynamo is multipolar, direct coupled to a twin-cylinder engine. Steam windlass and steam steering gear are also provided. The boat will have two masts, and will appear a very neat craft in the water.

Recent press dispatches from San Francisco reported that S. Anano, president of the Toyo Kisen Kabushiki, or Oriental Steamship Company of Japan, had arrived to establish a line of steamships between China, Japan, and this coast, with a terminus at this port. He had ordered three modern steamships for the line, each to be capable of carrying 600 passengers, besides having a dead weight capacity of 5,000 tons for freight. Mr. Anano said that if there is business enough he will maintain a weekly service.

SELECTED PATENTS.

578,697—STEAM-ENGINE. Nathaniel G. Herreshoff, Bristol, R. I., assignor to the Herreshoff Manufacturing Company. Filed Dec. 2, 1895.

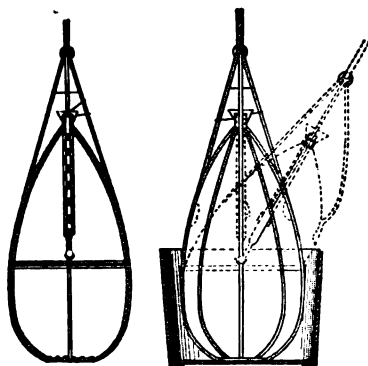
In an engine with two or more pairs of cylinders and cranks, having one cylinder of each pair above and partially overlapping its mate, the lower cylinder of the two pairs being in direct contact with each other and having the several valve-chambers out of the plane of the axes, the combination therewith of the frame connecting the upper cylinders, constituting with the cylinders a rigid supporting-girder performing the functions of a bed-plate, and the lower frames connecting such girder with the shaft-bearings, the last-mentioned frames being arranged so far out of the line of the cylinders as to allow the removal of the heads and pistons from the lower ends of the lower cylinders after detaching the slides



without disturbing the frames. 2. In a compound engine with the cylinder and cranks in pairs, the double-piston valves (see cut) working in the valve-chests (see cut) arranged as described the valve-chest for the high-pressure cylinders receiving steam between the pistons and exhausting at the ends, and the valve-chests for the low-pressure cylinders each receiving its weaker steam at the ends and exhausting from the space between the valve-pistons. 3. An engine having two pairs of cylinders, with double-piston valves for each, the valve for a cylinder of one pair having the steam-inlet pipe opening into the space between pistons and its exhaust connected with the space between pistons of the valve belonging to the second cylinder of the same pair, and the exhaust of the second valve being connected with the end spaces of the valves of both cylinders of the second pair.

578,568—OIL-DISTRIBUTOR FOR CALMING WAVES. Daniel Knowles, Norfolk, Va. Filed July 3, 1896.

In an oil-distributor, the combination of a bag having an internal spreader or brace near its lower end, and a filling tube having one end communicating

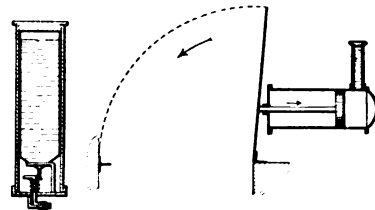
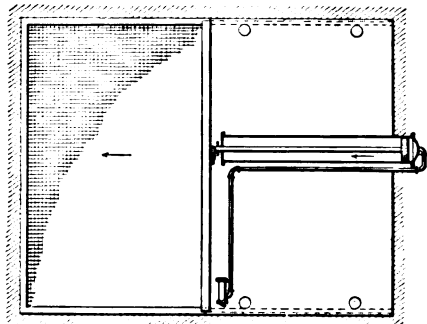


with the mouth of the bag and its other end loosely connected with the said brace. 2. The combination of a bag, and means for holding the end portion of the bag opposite to the mouth vertical, while the mouth and portion of the bag adjacent may be inclined to the vertical. 3. The combination of a bag, a stationary rod arranged within and connected to the bottom of the bag, a perforated filling-tube hav-

ing one end in line with the mouth of the bag and its other end loosely connected with the stationary rod, and a cap for closing the outer end of the tube. 4. The combination of a bag, a bottom plate for the plate, a rod extending upward from the plate, a ring or hoop arranged above the bottom plate and connected with the rod, a filling-tube loosely connected with the rod and extending to the mouth of the bag, and a cap for closing the outer end of the tube. 5. The combination of a bag, a stationary rod arranged within the lower portion of the bag and having a socket formed in its upper end, a filling-tube extending inward from the mouth of the bag and having at its inner end a ball fitting in the socket in the rod, and a cap for closing the outer end of the filling-tube. 6. The combination of a bag, a filling-tube connected with and extending inwardly from the mouth of the bag, and means connecting the tube with the bottom of the bag. 7. The combination of a bag, a filling-tube connected with both the top and bottom of the bag, and a cap for closing the outer end of the tube. 8. The combination of a bag, a bottom plate arranged within the bag, a brace extending continuously from such bottom plate to the mouth of the bag, the portion of such brace adjacent to the mouth of the bag being tubular to serve as a filling-tube, and a cap for closing the outer end of the tube, substantially as set forth.

578,028—APPARATUS FOR AUTOMATICALLY CLOSING BULKHEAD DOORS. Alexander von der Ropp, Berlin, Germany. Filed June 12, 1896.

In combination with the movable door, a piston connected therewith, a cylinder for the piston, a breakable vessel containing an expansible fluid, a



chamber containing said vessel and communicating with the cylinder, and means for breaking the said vessel and releasing the expansible fluid to operate the piston and the door. 2. In combination with the movable door, a cylinder, a piston therein for operating the door, and a fragile receptacle containing a fluid adapted to expand when released therefrom, said receptacle being arranged to be broken to discharge its fluid into the cylinder.

577,750—PROPULSION OF VESSELS BY RECIPROCATING PADDLES. John L. Helmolt, New York, N. Y. Filed June 2, 1896.

577,421—RECIPROCATING PROPELLER FOR VESSELS. Harmon Compton, Dunmore, Pa. Filed July 23, 1896.

577,797—HAND STEERING GEAR. William Tuttle, Natchez, Miss. Filed July 7, 1896.

ADMIRALTY LAW.

U. S. SUPREME COURT.

Maritime Lien Disallowed.

William H. Ziegler sought to enforce a lien upon the steamship *Valencia*, for coal which he had supplied to the New York Steamship Company, upon their order, while they had the vessel under charter. The coal was not delivered by the order or consent of the master, and all bills were sent to the company's office in New York. Mr. Ziegler was not aware that the vessel was under charter, resting satisfied with the knowledge that the company was directing its operations, nor did he pursue any inquiry in this regard. There was no agreement that the credit of the vessel would be pledged for the coal. The District Court sustained the libelant's claim and an appeal was taken. The Supreme Court was finally asked to decide, whether, upon the facts, the libelants obtained a maritime lien on the steamship for the coal, which had not been paid for. The court answered in the negative, holding that one furnishing supplies on the order of another having control and possession of a vessel, under circumstances which put him on inquiry as to the existence and terms of a charter party, can acquire no lien contrary to the provisions of the charter party.

Opinion by Mr. Justice Harlan. Attorneys F. R. Coudert and Joseph Kling for appellants. Attorneys W. W. Goodrich and J. A. Dedy for appellees.

Naval Sea Duty Defined.

Lieutenant Barnette, U. S. N., secured judgment against the United States in the Court of Claims, for \$780.25, the difference between shore pay, which the government had allowed, and sea pay, during a term of service on the naval school ship *St. Mary's*, in the port of New York. This service was performed under an order of the Secretary of the Navy, assigning the officer to "short duty," on the ship. The government appealed, and the court of last resort decided in favor of the officer.

The Supreme Court, after noting the differences between the pay for "sea duty," "shore duty," and "waiting orders," held that to constitute sea service three things only are necessary. The service must be performed "at sea," "under the orders of a department," and "in vessels employed by authority of the law." On the first point the court held, that under the statute, a vessel is at sea even though used as a training or receiving ship, at anchor or alongside a wharf, and not in condition to be taken out to sea. The appellee lived on the vessel, wore his uniform, and was subject to the regulations governing vessels at sea; consequently the designation, of the Secretary of the Navy, of the duty as "shore duty," was immaterial. As to the second point, the appellee had acted exclusively under the orders of the commander of the vessel, a naval officer also, and though the ship had been placed at the disposal of the Board of Education of New York, the possession, control, discipline, and authority were all retained by the federal government. As to the last point, even the court below had found, as a fact, that the *St. Mary's* was a "sailing vessel owned and employed by the United States." Under these circumstances, the appellee was entitled to sea pay, even though he had received during the period of service compensation from the State of New York, as nautical instructor.

Opinion by Mr. Justice Gray. Assistant Attorney General Dodge and George H. Cochran for the United States. Attorneys John S. Blair and Charles Abert for appellee.

U. S. DISTRICT COURT.

Personal Injury Case.

Laurence P. Butler was awarded \$1,200 compensation, with interest and costs, in a suit for damages for personal injuries, against the steamer *City of Kingston*. The steamer plies between Seattle and Port Townsend, carrying passengers. While making a trip, the libelant stepped on an iron lid in the deck, which covered a chute to the coal bunkers. The lid tipped and the passenger fell partially into the chute, and was badly hurt. Coal had been passed through the opening a short time previously, and when the lid was replaced it was not inspected by any of the executive officers. The court held that under the law the owner should have taken proper care that all openings in the decks, upon which passengers were allowed to walk, were securely closed or guarded. And where an injury to a passenger was occasioned by the giving way of any cover, it was incumbent upon the owner to show affirmatively that there was no fault or negligence on the part of the officers or crew.

Judge Hanford. District Court, D. Washington, N. D. Attorneys, R. W. Jennings and W. H. Gorham for libelant. James M. Ashton for claimant.

Compensation For Salvage Services Refused.

The barges *Pohatcong* and *Mayaug*, while going up the East River, New York harbor, in tow of the tug *Scranton*, grounded on Man-of-War rock, south of Blackwell's Island. The *Scranton* steamed off for help, and meanwhile the tug *Ramsey* came up and offered to pull the *Pohatcong* off. The master refused this aid, explaining that his tug had gone for assistance. The tug *Ramsey* lay nearby a long while. Finally her master made fast a line to the *Pohatcong* and hauled her off the rocks, and towed her to the flats near Twenty-sixth street, where she anchored, with little damage done. The owners of the *Ramsey* sought to recover compensation for their salvage services. The court dismissed the libel upon legal grounds. The captain of the barge testified that he had refused the aid of the tug because of general instructions he had received from the superintendent of his line. The court held that the situation was one fairly within the scope of the master's (*Pohatcong*) judgment, under his general instructions not to receive outside help in such cases, and that compensation for the salvage service, though of some value, must be refused.

Judge Brown, District Court, S. D. New York. Attorneys Carpenter and Peck for libelants. Hamilton Odell for claimants.

Tug Responsible For Safety of Tow.

The responsibility of a tug for the safe mooring of her tow was considered in this suit, in which the owners of the scow *Aurora* recovered damages from the tug *Governor*. The tug was towing the scow to sea in New York harbor, and was obliged to put back on the approach of a southeast gale. She moored the tow along the bulkhead forming the outside of the Atlantic Basin, which was safe from a southeasterly gale, but unsafe in high westerly winds. During the night the wind shifted to the westward, and the scow was damaged by pounding. The court held that the tug was in fault either for not taking the tow inside the basin, or else for not maintaining a sufficient watch during the night, with help at hand sufficient to remove the tow in time to prevent damage, upon any change of wind to the westward, which was a change to be reasonably anticipated.

Judge Brown, District Court, S. D. New York. Attorneys Goodrich, Deady & Goodrich, for libellant. Attorneys Macklin, Cushman & Adams, for claimant.

Salvage as Distinguished from Towage.

An award of \$1,500 was made by Judge Seaman to the North Michigan Transportation Company, owners of the steamship Charlevoix, for salvage service in towing into port the disabled freighter Waverley, on Lake Michigan. The Waverley, which had 47,000 bushels of corn aboard and two schooners in tow, was on a voyage from Chicago to Buffalo, when her machinery broke down. The schooners continued under sail and the disabled steamer blew signals of distress. The steamer Charlevoix, with passengers and miscellaneous cargo, bound to Chicago, answered, and was asked for assistance, the question of compensation being left open. The weather at the time was threatening with "a lump of a sea." This necessitated careful maneuvering and occasioned to the steamer towing "more risk than would be incurred in her regular voyage." The court held that the extent of the risk, which was assumed by the salvor, was not to be gauged by the results alone, and the fact that the towing line was speedily taken, and no mishap occurred, was entitled to no consideration only so far as it tended to show the state of the wind and sea. The value of the Waverley and cargo was put, by stipulation, at \$67,000, and the Charlevoix and cargo at \$75,000. The owners of the former had tendered \$500, but the court held that the purposes of the rule of salvage which grants compensation in the nature of a reward would not be fulfilled by narrowing the allowance so closely to the rate of mere towage. The court accordingly gave a decree for \$1,500 and costs.

Judge Seaman, District Court, E. D. Wisconsin. Attorneys Markham, Nickerson & Harper, for libellant. Attorneys Schuyler & Kremer for claimant.

NEW PUBLICATIONS.

THE MECHANICAL ENGINEERING OF POWER PLANTS. By Frederick Remsen Hutton, E. M., Ph.D., Professor of Mechanical Engineering in the School of Engineering of Columbia University, New York. John Wiley & Sons. 1st Edition, pp. 726. Illustrated. Price, \$5.

Every ambitious engineer wants to know the why and wherefore of all things connected with the generation and use of steam for the production of power. He desires to find an answer to the inquiries of his mind, in concise form, and unmixed with abstruse reasonings or difficult calculations, which more often than not obscure the practical facts which are sought. It is the purpose of this book to so inform the student; to put before him plainly, cause and effect of the various apparatus and agents involved. The general character of the work prevents any especial attention being given to appliances in use aboard ship, but the underlying principles are identical in steam machinery whether ashore or afloat. It widens the horizon of the engineer to become familiar with the advancement in steam generation and engine building in general. There is quantity and variety enough of illustration to make the text easily comprehensible.

Catalogues.

The 1897 catalogue of the Jos. Dixon Crucible Co., regarding graphite for lubricants, is now ready for distribution. It contains much information, practical and scientific, and is written especially for working engineers. Copies can be had upon application to the company.

"A Reminder" is a very convenient memorandum book in diary form, sent to all applicants by C. A. Daniel, 323 Market street, Philadelphia, Pa. It contains a great deal of valuable information of various kinds in addition to a daily diary, and is an exceedingly convenient book.

The subject of refrigeration on steamships has received much attention from the A. Gray Kilbourn Construction Co., Drexel Building, Philadelphia. Over 100 ocean lines have Kilbourn machines in use. Mr. Kilbourn has just produced a machine of small capacity, from 200 pounds a day upwards. This machine is especially designed for yachts and coasting steamer purposes, and is illustrated and described in a folder now issued by this company. Copies of this circular can be had by application to the company.

An eight-page folder 6 by 9 inches in size is being sent out by the Davis-Farrar Company, Erie, Pa., illustrating the Shepherd automatic engines. Four illustrations are given of the single expansion engine. The various features of these engines are briefly mentioned as well as the sizes made. This company is now at work on a large and more complete catalogue, which will describe fully all of the engines made, including compound, triple and quadruple expansion. Copies of the folders can be had upon application to the company.

A catalogue and price list of steam users' supplies has just been published by the Sims Company, Limited, Erie, Pa. A variety of devices are fully illustrated and described, including feed water filters, low water alarms, injectors, oil and grease cups, packing, water gauges, etc. The fact that Mr. Sims, president and general manager of this company, is an engineer of many years' experience, will be sufficient reason for every marine engineer who is interested in keeping posted on such matters to get a copy of this catalogue and read it carefully.

A convenient little catalogue is being distributed by the Standard Gauge Manufacturing Company, 602 The Cuyahoga, Cleveland, O., illustrating and describing the safety water columns manufactured by this company. These columns contain one float, one valve, and a single lever. The working of the column is thoroughly illustrated and described, and full information is given, such, for instance, as the most satisfactory way in which to attach the column to a boiler. This company is just arranging to push the sale of its columns in the marine field, and a reference to this catalogue will show the various advantages it possesses.

The recent demand for compact water tube boilers for use on steam launches and elsewhere where space must be economized has led to the introduction of a large number of such boilers. One of the latest is the Buckley patent safety water-tube boiler, manufactured by the Rochester Machine Tool Works, Rochester, N. Y. These boilers are arranged to carry high pressures up to 250 or 300 pounds. Any one interested in the subject of boilers, and especially small boilers for boats and launches, should send for a circular issued by this company, which describes the boiler quite fully and illustrates also the Acme marine or yacht engine manufactured by this company.

The demand for a feed water heater and purifier that would be suited to the needs and requirements of vessels on the Great Lakes led Robert Leavmonth, chief engineer of the Anchor Line steamers,

Buffalo, N. Y., to invent such a heater himself. His heater and purifier has now been in use for some years on many of the largest steamers on the lakes. Among the newest steamers to adopt them are the Crescent City, the Empire City, and the new boats of the Republic Line. Mr. Leavmonth is a practical engineer of many years' experience and will send a catalogue and other descriptions of his heater and purifier to all who are interested in the subject and will write for them.

A compound marine engine of approved design is illustrated and described in an eight-page folder which is being distributed by the Shipman Engine Manufacturing Company, Rochester, N. Y. The engines manufactured by this company have been well known for years and comprise all sizes from one horse-power upwards. The smaller sizes have been known for some years, and have a reputation that does not need further comment, but the compound is the latest development and several have already been put into use in various parts of the country. The largest one yet made has cylinders 6 by 12 by 8 in., occupies a floor space of 64 by 24 in., is 54 inches high and weighs 1,650 pounds.

The Worthington water tube boiler is one of the latest to be put upon the market. It is manufactured by the New York Safety Steam Power Company, 30 Cortlandt street, New York. The company is one long established in the steam engine business, and for many years it has been doing a considerable amount of marine work, especially in the way of furnishing engines. The need for an efficient water tube boiler to withstand high pressures and yet be compact and thoroughly practical, has led to the introduction of this boiler. The catalogue published by the company is very thoroughly and finely illustrated and goes into the details necessary to give a good understanding of what this boiler is. Every man interested in the subject of boilers would do well to send to the company for one of these catalogues.

In connection with a fine catalogue describing and thoroughly illustrating a complete line of diving apparatus and submarine armor, Andrew J. Morse & Sons, 140 Congress street, Boston, Mass., are sending out a description of the Morse improved telephone for divers. This telephone contains many improvements over the one formerly used, as it now comprises a hand telephone for use above water, and dry battery in a leather case with shoulder strap, a receiver and transmitter inside of the helmet for the use of the diver, and an electric cable in the center of a specially made line. The helmets are furnished with the transmitter and receiver in positions properly connected and ready for use at any time. The catalogue also contains a description of the Morse improved three cylinder air pump, which will furnish ample amount of air for divers to any depth that a diver can descend.

No neater brochure has ever been issued than the one now being sent out by the Vacuum Oil Company, Rochester, N. Y. It is entitled "From the Mail," and consists of a series of letters from a great variety of people speaking in the highest terms of the lubricating quality of the oils manufactured by this company. The illustrations are beautifully made and the printing and entire matter are of the very choicest work. Among the communications is one telling of the use of Vacuum oil upon the steamboats of the Newport & Wickford Company, and another from the William Cramp Ship and Engine Building Company, stating that Vacuum oils are used in the yards of this company as well as on all new vessels on their trial trips. Every user of lubricating oils should send to the Vacuum Oil Company for one of these publications, both for the beauty of the work, and for the valuable information contained. One can be had by mentioning Marine Engineering.

BUSINESS NOTES.

THE SPRINGFIELD ELEVATOR AND PUMP CO., Springfield, Mass., is now manufacturing the line of pumps so long and well known as the product of the Valley Pump Co., Easthampton, Mass. All sizes and kinds of pumps are made for marine uses, and many of them will be found in operation on the Mississippi River, as well as on Long Island Sound and on the sea coast.

THE SHIPMAN ENGINE CO., 200 Summer street, Boston, Mass., has been particularly busy this season in launch work. This company supplies various styles of marine engines from one h. p. upwards. All the necessary appliances are also supplied, including various types of propellers, wheels, steering gear, whistles and everything else that goes to make a steam launch comfortable and safe.

THE SCOTT ELECTRIC LAMP CO., 126 Liberty street, New York, finds that it pays to make a specialty. The search lights and lamps manufactured by this company are used on Government boats, river and lake steamers and along the coast. Some of the best known yachts in the country are also equipped with "Huntington" lamps. This company supplies all the requirements for search lights.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., through its New York manager, William Taylor, 106 Mail and Express Building, is having a good sale for fuse mains and other electrical devices for use on vessels which have electric plants. As these devices are adapted especially to this kind of work and have proved efficient, Mr. Taylor is rushing their sale in an energetic manner.

THE VIADUCT BRASS CO., Cleveland, O., is putting out a full line of brass goods for steam users' purposes. The latest is a reducing valve, which is being used on the lakes with marked success. This valve is fully described in these pages elsewhere. A catalogue descriptive of all the manufactures of this company has just been published and can be had upon application to the company, by mentioning Marine Engineering.

THE MARINE APPLIANCE CO., 36 Oliver street, Boston, Mass., is filling many orders for its new navy closet. These closets are designed to be safe against any sea pressure, and yet are in keeping with the latest sanitary requirements. They can be used either above or below the water line, and are made in various sizes and of various designs to suit all the conditions and requirements, from small yachts to large steamships.

THE CRANDALL PACKING CO., 136 Liberty street, New York, and Palmyra, N. Y., reports a large increase in orders for its various special packings during the past three months. Its expansion ring, sectional ring, and coil packings are treated by a patented cold oil process which thoroughly lubricates, yet leaves the finished product firm and elastic. This company furnishes packings to many of the principal steamship lines in the United States.

THE VANDERMAN PLUMBING AND HEATING CO., Willimantic, Conn., is finding a good demand for two specialties, which are of great use to marine engineers. One is the Vanderman chest, which is made of steel, in many large sizes. This chest is very strong and durable, and is particularly arranged for the tools that an engineer must have handy. The other specialty is a combination pipe vise, the value of which can be readily seen by referring to the illustration in the advertisement in our advertising columns.

THE A. GRAY KILBOURN CONSTRUCTION CO., Drexel Building, Philadelphia, Pa., is just putting on the market a novelty. It is the Duff Hand Drill, which is a surprisingly convenient tool. It is made with ball bearings, and can be operated with any ordinary bit brace in almost any position and under all conceivable conditions. The drill is designed to bore holes of any size up to, and including, one inch. Marine engineers have found them particularly valuable, because they adapt themselves to so many conditions and are so compact.

THE INTERIOR CONDUIT & INSULATION CO., 527 West 34th street, New York, makes a very large line of exhaust fans and blowers. These ventilators are operated in all ways, and especially by means of a Lundell electric motor. This company also presents a large line of blowers for use where fans are not ample or satisfactory. The ventilation of a ship below decks is very important and any one wishing to secure information on the subject would do well to make inquiries of the Interior Conduit & Insulation Co.

THE BELKNAP MOTOR CO., Portland, Me., is installing electric plants on the steamers Cumberland and State of Maine of the International Line. Both boats are being equipped with direct-coupled multipolar dynamos of 18 k.w. capacity, or sufficient to supply 300 incandescent lamps and a 10,000 c.p. search light. This company has already installed duplicate plants on the St. Croix of the International Line. This completes the equipment of light plants on the steamers coming into Portland, seven plants being furnished by this company, including the Bay State, Portland, Cottage City, Manhattan, and St. Croix and the above named. A New York Safety Steam Power Co. engine direct coupled with a Belknap multipolar dynamo is used on the Cumberland, and an Ideal engine made by the Harrisburgh Foundry & Machine Co. on the State of Maine.

